25 SEPTEMBER 1959

METAL INDUSTRY

THE JOURNAL OF NON-FERROUS METALS

VOL. 95 No. 7 ONE SHILLING

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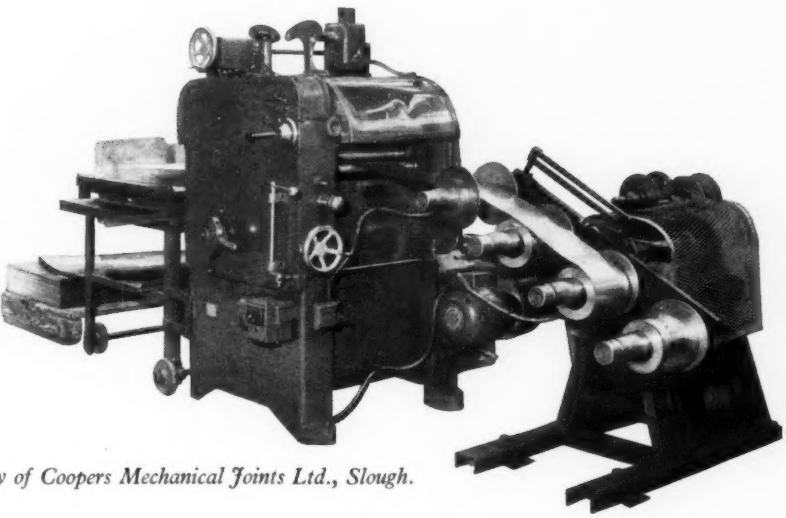

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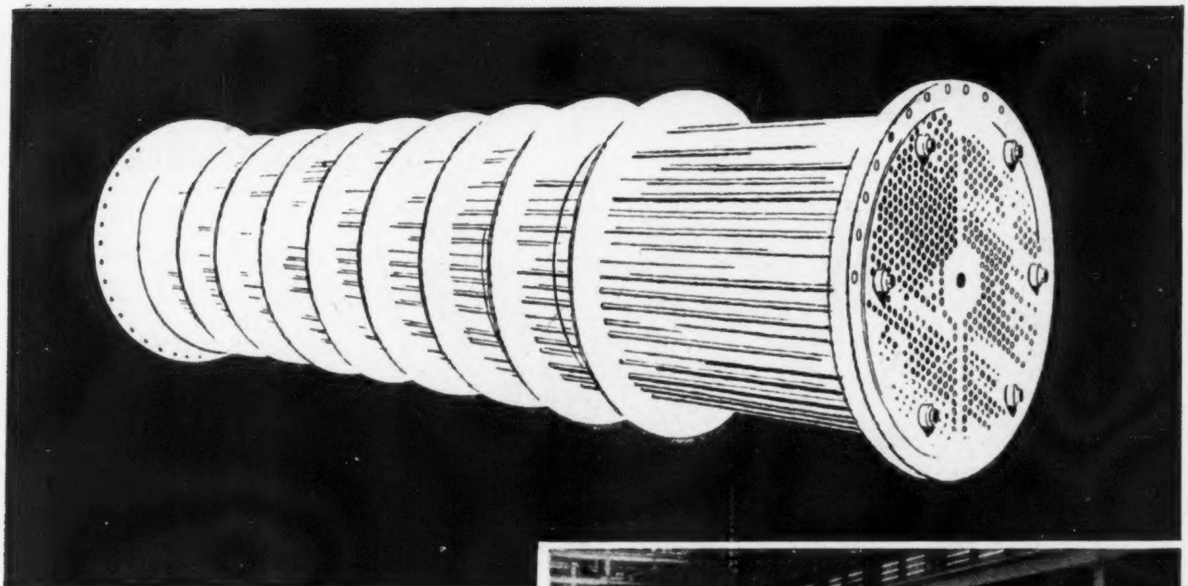

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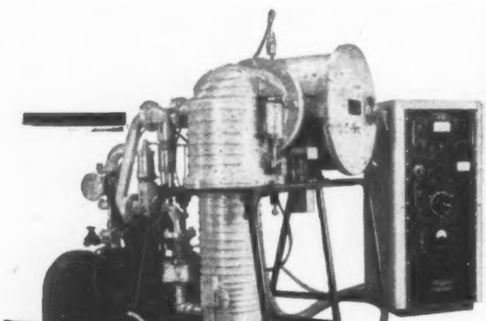

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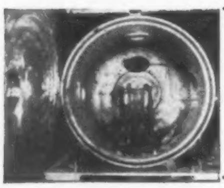

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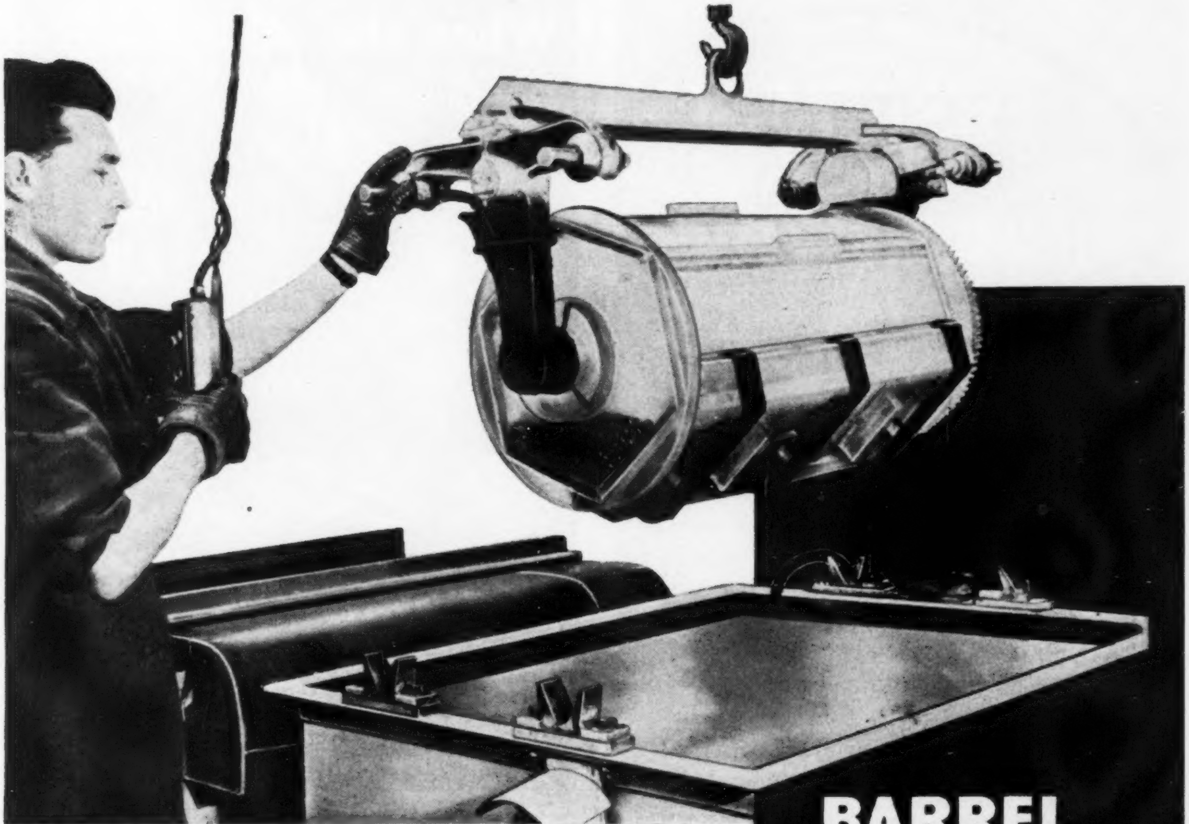


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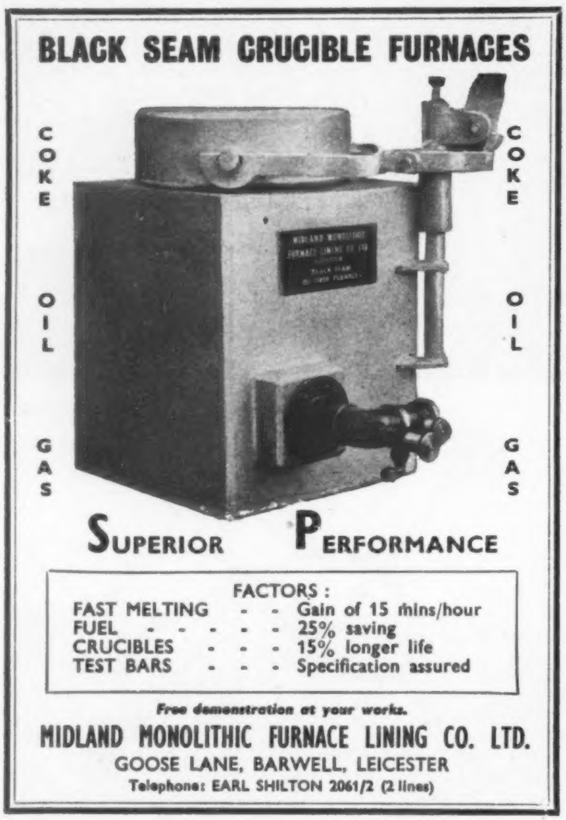
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METAL INDUSTRY

FOUNDED 1909

EDITOR: L. G. BERESFORD, B.Sc., F.I.M.

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METAL INDUSTRY

VOLUME 95 NUMBER 7 25 SEPTEMBER 1959

Any Suggestions?

IT was in 1956 that the Industrial Welfare Society carried out the first nation-wide survey on the subject of suggestion schemes in this country. The conclusion which they published was: "The justification for this survey is the conclusive evidence it gives, that although in each industry there are some highly successful schemes, the vast majority of schemes operating here are failures." This subject had been one of great concern in the United States before the last war, and it was considered of such great importance that in 1941 a group of far-seeing business men got together and formed the National Association of Suggestion Systems, the object being to concentrate exclusively on promoting the widest possible operation of successful suggestion schemes in that country. As a result, it has recently been estimated that the direct value of the suggestions which came in through such schemes in America last year was at least about £70 million, a result brought about just by developing, tapping and using the idea-power of ordinary men and women.

At a meeting of the Barrow in Furness Local Productivity Association, held last week-end at the College of Further Education in Barrow in Furness, Mr. P. Clavell Blount gave an address in which he urged the adoption of such an association in this country, and in the course of his remarks said that the trouble in this country was not so much a lack of information about suggestion schemes as that so many people still regard them as sidelines. The big lesson to be learned from those who have achieved success in this field is that, to be effective, a suggestion scheme must be taken just as seriously as any other function of industry, and that it must be promoted vigorously and continually. The benefits which will result from such a scheme will be in direct proportion to the seeds of enthusiasm and confidence which are sown in the minds of those in the rank and file. It is up to management to sow those seeds and to stimulate their growth. Rank and file employees, said Mr. Blount, need to be persuaded and constantly reminded that they all have some degree of creative ability, and that this can be developed and increased, almost without limit, to their personal benefit. They need to be relieved of the fears which may discourage them from "helping the bosses." And of greatest importance—it cannot be stressed too often—they need to be made to feel wholly confident that those in privileged positions will deal fairly with the ideas and suggestions which they put into the common pool.

If Britain is to be competitive in world markets, continued Mr. Blount, if we are to expand our production, maintain full employment, and improve our standards of living, we must be more willing to seek out and use new ideas. We need to do this not only in the workshop, but in every field of activity, and at every stage of the productive process, from the obtaining of raw materials to the selling of the finished products.

There will probably be many opinions, for and against, on Mr. Blount's scheme, but the existence of a body concentrating exclusively on promoting the best possible flow of new ideas, and encouraging the employment of the best ones, could surely not fail to be of the greatest benefit to British industry.

Out of the
MELTING POT

Worth Noting BOTH direct and indirect interest attaches to a method and apparatus that have been devised for effecting two-stage compression of ingots, in particular of iron and steel, for the purpose of improving their mechanical properties prior to subsequent rolling, forging, etc., the indirect interest possibly exceeding the direct interest. For the compression, the ingot is placed in a suitable receiver. In the first stage, the ingot is subjected to a pressure of the order of 30,000 kg/cm^2. This pressure is transmitted to the ingot from a pressure piston through a mixture of graphite and molybdenum disulphide. After this preliminary compression, additional pressure is applied to the ingot through the graphite-molybdenum disulphide mixture from a pressure generator in which the pressure is produced by the thermal expansion of a liquid, namely mercury. The mercury is contained in tubular passages in which it can be rapidly heated electrically so as to produce a pressure of about 300,000 kg/cm^2 in the ingot receiver. After the compression at that pressure has been finished, the mercury is rapidly cooled by a liquid passed through a cooling coil incorporated in the pressure generator. The direct interest attaching to the above two-stage compression treatment suffers, for the time being, from the lack of factual information as to the improvements in mechanical properties or any other characteristics that are, in fact, achieved. On the other hand, potential applications of isostatic, "hydraulic" compression are sufficiently numerous to ensure considerable interest in the use of the graphite-molybdenum disulphide mixture as a pressure "fluid." Compared with other pressure *fluids* it has the advantage of being usable, if need be, at elevated temperatures, the upper limit of which could, if necessary, be pushed upwards by the omission of the molybdenum compound. The mercury thermal expansion high-pressure generator is certainly also worth noting.

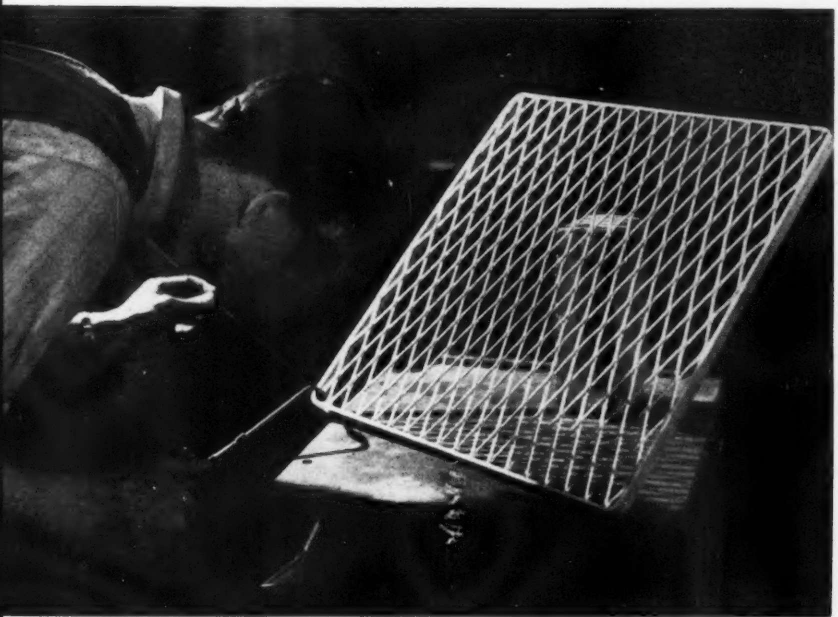
Unintended AT its annual meetings, the British Association appears increasingly to incline towards the practice of achieving its purpose of bringing science home to the layman by vigorously hammering it home. The possibility that the public might get shaken up by this process of hammering home is presumably regarded as desirable and, indeed, as one of the main advantages of the hammering. Another advantage is that a scientist laying aside his retort, test tube, microscope or other near-symbolic instrument appropriate to his profession, and picking up a hammer to do some hammering, is undoubtedly news, and as such is certain to be reported in the general press and thereby brought (hammered) home to the public. What is the effect of all this hammering? It certainly succeeds in driving the message home. Judging by such messages, however, one forms the impression that the scientists have been too preoccupied with this hammering to have given sufficient thought to what it is they were hammering and to its effects. Alternatively, would it be doing the scientists an injustice to suggest that their messages were, in fact, chosen in the definite hope that "this will shake them." It may have shaken them while the hammering was going on, or while the headlines and paragraphs were being scanned. Afterwards, however, the messages, or rather the impressions left by them, were found merely to reinforce existing impressions of science as science fiction, and of science as a source of problems to which it has no answer, and the corresponding impressions of scientists as impractical visionaries and of scientists as sorcerer's apprentices. Another impression that may well be added in view of some of the recent Papers is that of scientists as prophets of doom: a wise and laudable role, but one that is unlikely to bring scientists (like the prophets before them) much honour because of the unpopularity of their implicit or explicit call to repent before it is too late.

It's a Fact DO metal powders age? This question, which arose in connection with some discussion of the possible advantages of a closer link in time and space between the manufacture and use of powders, could hitherto be answered only in a general way on the basis that, since all freshly formed surfaces undergo changes, freshly prepared powders with their very large surfaces are likely to reflect such changes, in other words, they are likely to exhibit ageing. Some positive experimental evidence regarding this matter has now been provided by M. Clasing of the Degussa concern. He studied the effect of storage, in some cases for up to 3,200 hr., on four silver powders produced, respectively, by electrolysis, cementation on copper from acid silver nitrate, by chemical reduction of silver carbonate, and by cathodic reduction of silver oxide. The investigations covered a wide range of powder-metallurgical properties (sieve analysis, angle of repose and bulk densities of loose powders, on densities and bend strength of green compacts, and on densities of sintered compacts). All the powders, after being prepared, had been thoroughly washed and then dried for 1 hr. at 240°C. In spite of the fact that this may well have detracted somewhat from the "freshness" of the powders, quite considerable changes during subsequent storing were found to occur in the case of the reduced powders; there were no appreciable changes in the various properties of the electrolytic powder and the powder obtained by cementation. In the case of the two reduced powders, while the bulk densities and the compact density remained constant, ageing caused a reduction in the density of sintered compacts, this effect being more marked for sintering in hydrogen than for sintering in air, with the result that powders which had been stored for a long time yielded higher densities when sintered in air than when sintered in hydrogen, the reverse being true for the "fresher" powders. Ageing also produced a marked shift in the sieve analysis to finer particle ranges, and some reduction of the angle of repose. Substantially the same changes, with, in particular, the same reduction in sintering ability, were brought about by an artificial ageing (1 hr. at 300°C. in air) of the reduced powders. It is suggested that ageing is connected with changes in the active spongy surface condition of the reduced powders. The results also suggest that now that the occurrence of the phenomenon has been established, much more work on the ageing of metal powders, including some really freshly-prepared powders, would be of great interest.

Skimmer

Brazing Aluminium Alloys

I—PRINCIPLES



[Courtesy British Oxygen Co. Ltd.

Brazing 1 in. mesh ⅛ in. square strands on an aluminium food tray

BRAZING of aluminium and its alloys is covered by B.S.S.499: 1952, which states: "In general the melting point of the filler metal is above 500°C". In this respect, and broadly in its application, brazing lies between soldering and fusion welding; soldering requires a filler of lower melting point and produces joints of comparatively low strength, whilst fusion welding melts the parent metal—with or without added filler.

There is a distinction between the brazing of aluminium and that of other metals. For aluminium, the brazing alloy is one of the aluminium alloys having a melting point below that of the parent metal, whereas for other metals the brazing alloys are often based on copper-zinc alloys, brasses—hence the term "brazing"—and are necessarily dissimilar in composition to the parent metal: copper is the commonly used brazing material for the flux-free brazing of mild steel in reducing-atmosphere furnaces.

There are three main methods of brazing aluminium; flame or torch brazing, furnace brazing, and flux-dip brazing.

Flame brazing is a process in which heat for brazing is obtained from a gas flame from a manually-operated blowpipe or torch. It involves feeding the brazing alloy, in the form of a filler rod which has been prefluxed, to the point at which it will melt and flow into the joint. It is the oldest method, and is used mainly for small quantity production or for joints in large structures which, because of their size, cannot be brazed in furnaces.

Furnace brazing is a process in which brazing heat is obtained by putting a complete workpiece into a furnace which may contain a protective atmosphere—a condition which is, however, of no advantage for aluminium. Here, the brazing alloy is in the form of a prefabricated washer or other shape, or as a surface coating on the sheet, and is placed in position in the joint, or in close proximity to it, before the assembly is placed in a furnace. This method is widely used for large batch or continuous production.

Flux-dip brazing involves prelocating the brazing alloy as in furnace brazing; the assembly is then preheated and dipped into a bath of molten flux, which is held at a temperature above the melting point of the brazing alloy. This process is suitable for large quantities and complicated assemblies, and it has the advantage of bringing assemblies to the brazing temperature rapidly and with little risk of overheating.

Other methods of brazing metal, such as flow brazing—in which molten brazing alloy is poured into the joint—and resistance brazing, have not yet been sufficiently developed for aluminium. Induction heating and block brazing methods have been used successfully for aluminium but are not practised to any significant extent at present.

The choice of brazing method obviously depends on workshop conditions, equipment available and quantities required, as well as the innumerable factors involved in the economic manufacture of the product.

Flame brazing may be used to fabricate almost any assembly, and gives particular advantage where the joint area is small in relation to the bulk of the assembly. Flame brazing is also more widely used for brazing the heavier-gauge materials. Equipment is comparatively cheap and is mobile; small quantities of products may be quickly produced, hence its frequent adoption for experimental and small batch production.

Furnace brazing has a wide application, due to its adaptability for intermittent batch production and larger quantities. It is especially suited to assemblies of hollow construction with small openings, where buoyancy problems and difficulties in internal flux removal associated with flux dip brazing are eliminated.

The heat-treatable alloys suitable for brazing lend themselves to furnace brazing rather than to flame brazing. Furnaces are costly and the method necessitates a separate fluxing operation, but the equipment is readily brought into operation or shut down as required.

Flux-dip brazing is applicable to self-contained—and preferably self-jigging—assemblies that are easy to drain. It is most suitable for very large production runs. It must, however, be foreseen that the buoyancy of the molten flux bath, and turbulence caused by the immersion of assemblies, tend to dislodge the components, which must, therefore, be interlocked, joined or jigged to prevent this.

On the other hand, the buoyancy of the flux may be of advantage for thin components, especially those of large span: once safely immersed they are less likely to distort under their own weight. For the same reason, the brazing alloy tends to be held more securely in position when immersed in liquid flux.

An immersed-electrode type dip plant is more expensive than a brazing furnace of similar capacity, and running expenses can be high if wasteful drag-out is permitted or the flux is allowed to become contaminated.

The wrought forms of commercially-pure aluminium, aluminium-1¼ per cent manganese alloy and aluminium-magnesium (less than 2 per cent)-silicon alloys are amenable to brazing. Aluminium-magnesium alloys containing more than 2 per cent magnesium are difficult to braze as the oxide film is tenacious and difficult to remove with ordinary brazing fluxes. Joints

[Courtesy British Oxygen Co. Ltd.

Flame brazing aluminium alloy chimney to corrugated aluminium roofing

may also be brittle, as the silicon of the brazing alloy combines with the magnesium to form brittle intermetallic constituents; this is especially so if excessive heat is applied.

Other alloys cannot be brazed because they start to melt at temperatures below that of any available brazing alloy. The lowest permissible temperature of first melting depends on the type and size of joint, and the thickness of the sections to be joined, but it varies from 590°C. for aluminium-magnesium-silicon alloys to 660°C. for 99·99 per cent super-purity aluminium.

None of the common standard casting alloys has a melting range completely above that of the available brazing alloys, thus the brazing of castings is not generally attempted. Techniques have been worked out for certain alloys and applications, but the problems of distortion and incipient fusion created when the castings are raised nearly to their melting point make the process less attractive than other methods of joining castings.

Aluminium-silicon alloys of nominal 5 per cent, 7½ per cent or 10 per cent silicon content are used for brazing aluminium and the aluminium-1¼ per cent manganese alloy. B.S.S.1942:1953 gives four aluminium alloys used as brazing alloys, their melting ranges being from 550°C. to 625°C., and their brazing ranges from 570°C. to 640°C.; all contain silicon (from 4·5 per cent to 13 per cent) and one contains from 2 per cent to 5 per cent copper.

Brazing alloys having lower melting points are available for other wrought alloys and for the casting alloys.

The brazing process chosen governs the form in which the brazing alloy is used. In flame brazing, rod or wire is fed into the joint by hand, but the furnace and flux dip methods allow the use of brazing alloy in different forms, such as wire, rod, strip, bands, rings, staples, washers and brazing sheet.

For dip brazing, a paste filler—easily applied by brush—may be used for many applications. Its use eliminates the need for preformed sheet and wire.

Aluminium alloy sheet and strip which are coated with a brazing alloy on one or both sides are available; their use simplifies assembly and eliminates the need for separate inserts. The brazing alloy also flows more readily, resulting in more consistent and reproducible joints.

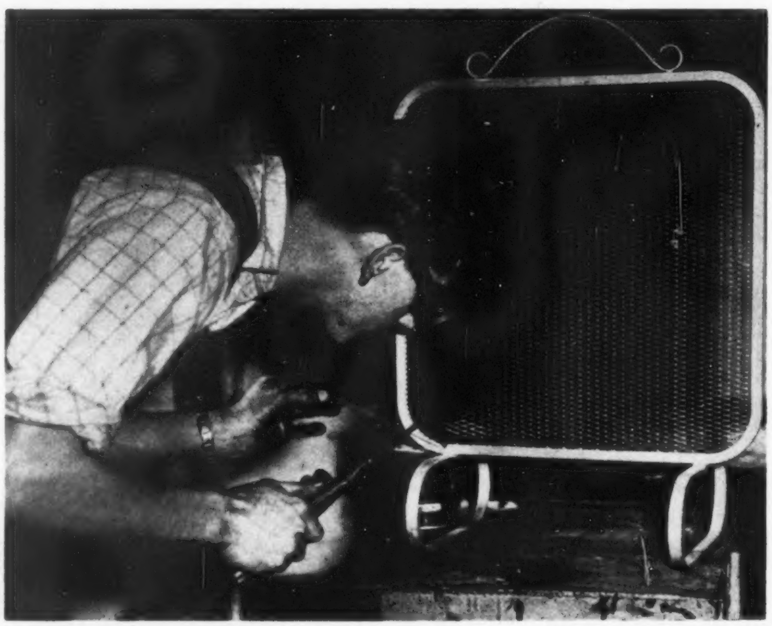
To ensure sufficient metal for joint making, sheets of 18 S.W.G. and less should have a coating of 10 per cent of the total thickness, but for thicker material 5 per cent is usually sufficient. Brazing sheet can be manipulated by hammering, bending or drawing in a press, in the same manner as plain sheet. Components made from it are fully softened by the heating to which they are subsequently subjected in brazing.

Assemblies consisting entirely of clad brazing sheet normally require no additional brazing alloy, but if extra brazing alloy is required it should be of a higher silicon content than the cladding.

The cladding usually contains 5 per cent or 7½ per cent of silicon, and is most commonly used with a parent metal base of either aluminium-manganese or aluminium-magnesium-silicon alloy. Clad sheet with a coating containing 5 per cent silicon has a higher brazing temperature than that containing 7½ per cent. Clad brazing sheet is not yet covered by the British Standards Institution, but its use is permitted by the Ministry of Supply Specification D.T.D.900J.

Brazing $\frac{3}{16}$ in. expanded aluminium into a fireguard

[Courtesy British Oxygen Co. Ltd.



Seven properties are required for an effective flux for brazing aluminium and its alloys:

It must remove the oxide coating present on the surfaces to be joined. It is always important that the flux is suitable for the parent metal, but especially so in the joining of aluminium-magnesium alloys. It must thoroughly wet the surfaces to be joined so that the filler metal may spread evenly and continuously. It must flow freely at a temperature just below the melting point of the filler metal. Its density, when molten, must be lower than that of the brazing alloy. It must not attack the parent surfaces dangerously in the time between its application and removal. It must be easy to remove from the brazed assembly. It should remain consistent and be stable in storage, transit and service.

Borax-base fluxes have a melting point of over 750°C.; they are also unsuitable for brazing aluminium and its alloys because they do not dissolve or otherwise remove the stable refractory oxide film.

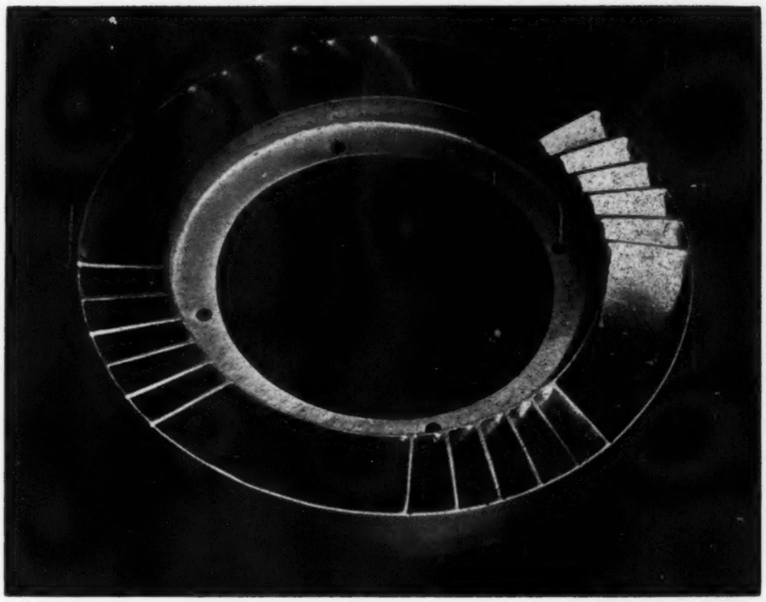
Many types of proprietary fluxes are available for brazing aluminium and these are generally of the alkali halide type, which are basically mixtures of the alkali metal chlorides and fluorides. Small amounts of one or more of the chlorides of manganese, chromium, cadmium, zinc, iron, cobalt, nickel, tin, lead, copper, antimony and silver are claimed to improve the performance of torch and furnace brazing fluxes. Fluxes and their residues are corrosive —the effectiveness of fluxes claimed to be non-corrosive should be confirmed.

The correct formulation of a flux may involve considerations of some complexity, and in general the flux suppliers should be consulted on the flux appropriate to a given brazing process.

A standard aluminium brazing flux containing essentially chlorides of sodium, potassium and lithium gives satisfactory results when used with aluminium which has been previously chemically cleaned and where surface oxidation is slight.

Where no cleaning of the aluminium surface is possible before brazing, a flux containing zinc chloride may be necessary to provide ready wetting by the brazing alloy. This type of flux deposits metallic zinc on to the aluminium surface, over which the fused brazing metal will flow more easily. A too-heavy zinc deposit, however, may have an undesirable effect on the mechanical properties of the filler metal finally deposited, and a safe figure for the amount of metallic zinc is that represented by a zinc chloride addition to the flux of not more than 7·7 per cent by weight.

Care should be taken in handling aluminium brazing fluxes containing fluorides, as toxic effects may follow the inhalation of fumes from these compounds, and personal contact may result in skin complaints.



[Courtesy Marston Excelsior Ltd

Dip-brazed air-guide vane assembly in aluminium-magnesium-silicon alloy

Consideration of the materials, the characteristics of the process and the function of the finished article is of paramount importance in joint design. Compromise is often necessary in design between joints that are most appropriate for the brazing process and those best for the article. Parts should be designed to be self-locating as far as possible, with resort to jigs only if found essential.

Under brazing conditions, the free flow of the brazing alloy is retarded by the high rate of dissolution of the parent metal into it; the brazing alloy is also unable to displace readily the fluxes from long lap joints. In brazing aluminium, therefore, greater use is made of fillets than of close parallel gaps in joints. Clearances should be sufficient to provide adequate fillets around joints, but small enough to ensure capillary flow.

The importance of good joint design to ensure adequate capillary flow of the brazing alloy cannot be overemphasized. Because of the dependence of brazing on capillary flow, line contact between parts to be joined is particularly important in furnace brazing. Line joints between parallel edges, and also tapered joints, permit ready flow of brazing alloy which will sweep out the dross and flux, forming good, strong fillets.

Square butt joints should be avoided when high strength is required. Lap joints are preferred, but where large areas of flat contact surfaces are involved it may be difficult to avoid some flux inclusions or gas entrapments in the joint. Flux inclusions remain inert unless moisture penetrates; then corrosion starts which may cause deterioration of the joint.

Straight laps of over ¼ in. should preferably be tapered, with a minimum angle between mating surfaces of 3°. Clearances for laps of less than ¼ in. range between 0·006 in. and 0·010 in. With wider laps the amount of taper and clearance becomes more critical, and should be increased as the width of lap increases, the optimum clearance being determined by trial. Normally, gaps of more than 0·02 in. are not satisfactory.

The positioning of a joint in an assembly depends on many local circumstances. The only general point is that joints of all kinds are better placed at points of low stress; smaller joints are then adequate and more economical to make.

Furnace and flux-dip brazing demand a more accurate fit than flame brazing, where the operator can supply extra brazing alloy when required.

As the brazing temperature is higher than the recrystallization temperature of aluminium or its alloys, annealing takes place during brazing. Thus, assemblies made from non-heat-treatable alloys should have their design based on the strength of the annealed alloy.

Suitably-designed assemblies made from heat-treatable alloys of the aluminium-magnesium-silicon type can be strengthened by quenching after brazing followed by natural or artificial ageing. Quenching may be in cold or hot water, water spray or air blast. Alternatively, after brazing, assemblies may be re-heat-treated to restore the full strength of the parent alloy.

However, it has to be assumed for practical purposes that strengthening of the actual filler in the joint does not occur during the heat-treatment process. Therefore, joints in heat-treated assemblies must be designed on this

TABLE I—JOINTS IN HEAT-TREATED SHEET

Ageing	U.T.S. tons/in^2	Elongation per cent on 2 in.
At room temperature	12·8	20
At 165°C. for 18 hr.	16·7	10
Solution treated at 540°C. for 30 min., then aged at 165°C. for 18 hr.	21·0	11

assumption, ensuring adequate strength for the purpose required, as they will be weaker than the parent metals used.

The figures in Table I are results of tensile tests on joints made between 18 S.W.G. sheets of aluminium-magnesium-silicon composition, using an aluminium-10 per cent silicon alloy. The brazing treatment in each case was preheating at 580°C. for 30 min., then at 610°C. for 1 min., then cooled slowly in air.

The aluminium alloys most suitable for brazing and most compatible with the brazing alloy are also the alloys especially noted for their resistance to corrosion. Salt spray and atmospheric exposure tests have shown that brazed joints, properly made and free from flux residues, do not deteriorate unduly under severe conditions, and are equal to comparable welded joints in which the parent metal and filler alloy differ. Anodizing or a suitable paint treatment gives additional protection.

With correct design, no appreciable increase in electrical resistance due to the brazed joint is noted in brazed components. Tests on brazed aluminium busbars have shown increased resistance equivalent to an extra 0·02 in. on a 24 in. length bar, which, for practical purposes, is negligible.

It is only possible to apply reliable inspection to brazed joints if it is carried out with a sound knowledge of the product and its purpose and a background of the processes and standards used in its manufacture. Some joints require mechanical strength, others must be leak-tight, and yet others require good electrical and/or thermal conductivity between components.

Quality control of incoming materials, combined with process control of the brazing operations—times, temperatures and the use of correct techniques—are the surest ways of producing good quality work.

For the inspection of brazed joints, the above, combined with suitable percentage checks, suffices in most cases.

Aluminium may be brazed to other metals, notably mild steels, although recourse to brazing is advocated only where a more normal jointing method—such as mechanical jointing or adhesive bonding—is not applicable. For the best results, parts must be thoroughly cleaned and pickled immediately before brazing, but even so the joints are weaker than all-aluminium joints.

Aluminium may, however, be applied as a coating to steels, and all-aluminium brazed joints of good quality may then be made by normal techniques. Brazed joints between uncoated aluminium and nickel-coated steel are fairly satisfactory but not entirely dependable for exacting service. Aluminium may be brazed to zinc-coated steel, but joints tend to be brittle. Joint strengths in these cases depend on the bond between the coating and the steel; also, joints between dissimilar metals are subject to bimetallic corrosion if used under moist conditions.

Although the brazing of aluminium to copper, brass, Monel, cast iron, stainless steel, and other alloys containing chromium, has been carried out, the processes are difficult and require special techniques to avoid brittleness. It is, however, possible to make joints not required to stand flexing; such joints must be adequately protected against corrosion. Aluminium cannot be brazed to magnesium as the resulting joint is too brittle to be of any use.

Apart from coating the second metal with an intermediate compatible layer of another metal, the methods of brazing to aluminium are much the same as for all-aluminium joints, but generally only flame brazing, and to a lesser extent furnace brazing, are used.

Increasing Forging Die Life

FORGING and other dies that operate at temperatures above 350°C. frequently suffer from heat-checking or "crazing," this condition being one of the major factors in die breakdown. Two die facing materials, claimed to give increases in die life of 25 to 80 per cent, are being used in the U.S., according to an article in *Iron Age*. Both products, one which is largely nickel, the other being nickel and tungsten carbide, are applied as paint-like materials, either by brush, dip or spray.

One of these, Pyro-Plate nickel, is applied to the working surfaces of the die, heat-treated in a reducing atmosphere to 900°C., and allowed to cool in atmosphere. The dies may then be given any desired heat-treatment. The nickel is said to diffuse into the base metal, forming an alloy layer. The coating is highly-resistant to oxidation and corrosion, and may be precipitation-hardened to 65-68 Rc.

This nickel coating has been successfully used for forming high-temperature, high strength aircraft alloys, one method being to form the metal between electrically-heated dies to reduce spring-back. Another method involves heating the sheet between electrically-heated flat dies, after which it is quickly removed and formed to the required shape. In these operations, dies of free-machining low grade steel were plated with "Pyro Plate," giving a life of over 1,000 hr. at 540°C. without breakdown.

The second coating process, primarily intended to combat die abrasion, uses a composite material containing up to 80 per cent by weight tungsten carbide. The coating may be only 0·0005 in. up to 0·003 in. thick, but can be precipitation-hardened to 68-70 Rc, and when properly supported by a hardened substrate shows exceptional resistance to impact as well as abrasion.

In one application where special bolts were being hot-headed, improved die life of 25-50 per cent has been obtained, and a 50 per cent improvement in surface wear alone is said to have been achieved.

Low Frequency Induction Melting

A RANGE of mains frequency induction furnaces of the channel type has recently been developed by ASEA, Sweden, whose licensees and representatives in the U.K. are Fuller Electric Limited, Fulbourne Road, London, E.17. The range includes a holding furnace with capacity for an effective charge of 1,200 lb. brass (375 lb. aluminium), a melting and holding furnace with an effective charge of 500 lb. aluminium and a series of tilting furnaces.

The holding furnace type LFR21/20 has a straight horizontal cleaning channel and straight vertical melting channels. The melting capacity is 88 lb/hr. and the current consumption 500 kWh/ton.

The stationary melting and holding furnace type, LFR83/40, has two chambers connected by two oblique channels that can be cleaned while the furnace is in operation. The melting rate is 165 lb/hr., and current consumption 535 kWh/ton.

Tilting furnaces in the range are, with one exception, hydraulically operated, have horizontal cleaning channels, and an inductor unit that can be rapidly changed. A variety of sizes from 625 lb. upwards is available.

EXPERIENCE WITH HILGER DIRECT-READING ATTACHMENT TO MEDIUM SPECTROGRAPH

Analysis of Zinc, Lead and Copper-Base Alloys

By P. T. BEALE

(*Platt Metals Ltd.*)

WITH the Hilger Direct-Reading Attachment to the Medium Spectrograph[1,2] the spectrographer has available eleven photomultiplier cells for the recording of eleven lines throughout the spectrum. The choice of lines is limited by the physical size of the slits arranged along the focal curve so that in general no two lines can be closer than approximately 3¼ mm.

The choice of lines is a most important stage in the installation of any direct reading equipment and it cannot be emphasized too strongly that the closest liaison is required between the manufacturer and the user. Preliminary investigations in the manufacturers' laboratory on actual samples enable modifications in line selection to be made before the instrument is installed.

Choice of Lines

For the analysis of zinc and zinc die-casting alloys, lead and its alloys and copper-base alloys, the final choice of lines was as follows:—

Cd 2265
Sb 2311
As 2349 } Sharing a single cell
Fe 2382 }
Mg 2791
Sn 2840
Bi 2938
Ni 3050
Cu 3274
Zn 3345
Pb 3683
Al 3961 } Sharing a single cell
Hg 5461 }

In most cases the most sensitive line available was chosen unless precluded by other considerations. It was found that the sensitive lead, zinc and copper lines, which were essential for trace determinations, were quite satisfactory as internal standard lines. This obviated the need for a second weaker line being selected as internal standard for each type of material and released cells for other useful elements. It should be mentioned that the majority of the author's work to date has used a condensed spark where line reversals are reduced to a minimum.

Other points may be noted concerning the line selection: Bi 2938 was substituted for Mn 2949 after the instrument had been put into service and the run of work showed that it was more important to have a rapid determination of bismuth in lead-base alloys than manganese in copper-base alloys. Unfortunately the earlier selection of Ni 3050 prevented the use of the sensitive Bi 3067 without making major alterations to the slit assembly. As twelfth element, AS 2349 was also inserted at a later date and it shares a single cell with Fe 2382 so that the operator may elect to read either iron or arsenic by operating a small shutter located between the slit and the photocell. A similar device is used for the Hg and Al lines where the former is used to monitor the temperature-compensating control.

Particular features of the instrument are illustrated in Fig. 1. Interchangeable electrode holders are available for use with either disc or pencil type electrodes. An auxiliary optical bar set normally to the main bar carries a second spark stand which may be used for methods requiring a vertical spark discharge, such as the globule arc or the porous cup or rotating disc solution methods. A double mirror device, located at the juncture of the two bars, may be raised into position to throw an image from the second stand on to the slit and at the same time rotate it through 90° to obtain the horizontal image of the spark discharge which is required for maximum stability of measurement.

Of the general performance of the instrument it is sufficient to say that the electrical and optical arrangements are such that the ratio of intensities of two wavelengths from a steady source may be measured with a coefficient of variation of 0·25 per cent. By far the greater part of the error on any analysis arises from the sample itself and the excitation conditions.

Lead and Lead Alloys

The Direct-Reader was required to control stages in the production of refined lead from secondary material and the manufacture of cable alloys to B.S.801 B, C, D and E.

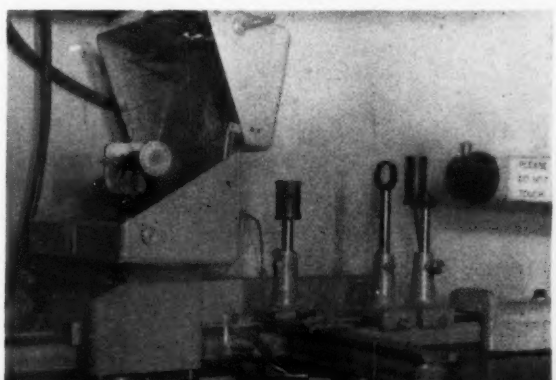
Initially attempts were made to standardize on rolled flat wedge-shaped electrodes which have been used successfully for a number of years for the analysis of cable alloys by photographic methods. However, it was found impossible to obtain good calibration curves or the required reproducibility by this means, apart from difficulties in mounting this type of electrode precisely in the horizontal spark stand.

The use of a disc type sample, which is machined on the lower chilled face and sparked against a graphite counter electrode, overcame these difficulties. The sample is taken in the foundry in a simple open iron mould.

A condensed spark source is used with a 10 sec. pre-sparking period and an approximate 25 sec. exposure, which is controlled by the Pb line 3683, which is plugged into the auto socket as the internal standard. Reproducibility is of the order of 1·5-2·0 per cent of content and agreement with chemical analysis is generally within ±0·01 per cent over the range 0·1-0·9 per cent tin, antimony and cadmium and within ±0·001 per cent for copper contents between 0·01 and 0·1 per cent. The other elements available are read off as impurities when the limits of detection are:—

Sn 0·001
Sb 0·001
Cu 0·0001
Bi 0·005
Zn 0·001
Ni 0·001
As 0·002
Cd 0·001

The Direct-Reader can also analyse antimonial lead alloys with antimony contents up to 10 per cent. The accuracy is again 1·5 to 2 per cent of



The Hilger Direct-Reading Attachment in position on the spectrograph

content. With these alloys a considerable systematic effect of tin on the antimony determination was noted and an empirical correction factor, depending on the tin content, is applied. The effect of increasing tin content is to enhance the antimony reading and the magnitude of the effect may be judged from the fact that the presence of 0·25 per cent tin gives an apparent increase in 8 per cent antimony of 0·3 per cent.

Printing metal alloys containing tin and antimony covering compositions varying from 2 per cent tin/2 per cent antimony to 10 per cent tin/16 per cent antimony may also be analysed successfully. Again, the varying tin content affects the antimony determination but direct comparison between the sample and standard alloys of similar composition gives adequate accuracy. For this purpose a large number of chemically analysed standards is essential. Care must be taken in pouring the disc samples in this type of material which is very prone to segregation effects. Discs should not be more than ¼ in. thick and should be poured in a cold mould.

Zinc and Zinc Alloys

The instrument is changed over quite simply to the analysis of zinc and zinc alloys by the following sequence of operations:—

(1) The disc holder in the spark stand is changed for a pencil electrode holder by operation of a single thumbscrew.

(2) The plug from the cell associated with the lead line is withdrawn from the "auto" socket and the zinc line 3345 is inserted in its place as the internal standard.

(3) The stepped coarse sensitivity controls are changed to the appropriate settings.

Chill-cast pencil electrodes with machined ends are used with a condensed spark discharge fixed at 15,000 v, 0·005μF., 0·03 mH added inductance and a 2 mm spark gap. The following ranges of content are covered:—

Sn	0·01-1·5	per cent
Pb	0·01-2·0	,, ,,
Cu	0·01-1·5	,, ,,
Fe	0·01-0·5	,, ,,
Al	0·01-6·0	,, ,,
Mg	0·01-0·1	,, ,,
Cd	0·01-0·5	,, ,,

In the case of trace impurities in zinc alloys, the sparked electrodes are reinserted in the spark stand, sensitivity settings are increased and an intermittent A.C. arc is passed to cover the following ranges of content:—

Sn	0·0003-0·01	per cent
Pb	0·0005-0·01	,, ,,
Cd	0·001 -0·01	,, ,,

By using standards free of these impurities a background correction may be deduced and applied to give linear working curves when plotted on log-log paper. Reproducibility in the case of zinc die-casting alloys is shown by the following coefficients of variation:

Element	Content (per cent)	Coefficient of variation
Al	4·1	1·4
Cu	1·0	3
Mg and Cu	0·05	3
Fe	0·03	5
Sn, Pb and Cd	0·002	5-10

Copper Alloys

The routine analysis of some copper-base alloys has been established by using a chill-cast pencil electrode against a graphite counter electrode and a simple condensed spark discharge. The Cu line 3274 is plugged in the "auto" position as internal standard.

Leaded brasses containing up to 3 per cent lead, 1 per cent tin, 0·5 per cent iron and 0·1 per cent aluminium may be analysed in a few minutes for these elements. The pencil electrodes are subject to segregation of lead and differences of up to 0·5 per cent between top and bottom of a rod were found. Good correlation was obtained, however, between the spectrometric result obtained by sparking on the lower chilled end of the pencil and the chemical analysis carried out on sawings taken from an ingot of the corresponding melt in the recognized manner. The other elements which were determined showed no sign of this segregation.

Typical coefficients of variation obtained on leaded brass were tin 0·75, lead 3·4, iron 2·5.

At present the instrument is used for two other determinations in copper-base alloys which are difficult and time-consuming to estimate chemically. These are zinc in aluminium bronzes up to 1 per cent and aluminium in various brasses up to 1 per cent.

Possible Future Developments

The Direct-Reader is almost fully occupied with the determinations which have been described; nevertheless there are several possible extensions of its coverage, particularly on copper-base alloys:—

(1) The use of a more arc-like discharge would lower the limits of detection to permit, for example, the determination of lead and zinc down to 0·01 per cent in tin bronzes.

(2) The use of solution methods might be effective on alloys with high lead content, such as the leaded gunmetals.

The author expresses his thanks to the Directors of Platt Metals Ltd., for permission to publish this information.

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[1] D. J. Webb; Hilger Journal, 1955, Nov., 2, 2, 19.
[2] F. Holmes; *J. Brit. Inst. Radio Engrs.*, 1955, March, 163.

Welding Thin Materials

MANUAL and mechanized welding of thin material with excellent control of the weld puddle are features of a welding method, called "Short-Arc" welding, developed by Linde Department, Union Carbide International Company, Division of Union Carbide Corporation. This inert-gas consumable-electrode process makes possible manual fusion welds in the range of thickness of 0·03 in. to 0·10 in. (0·76 to 2·54 mm.) of all common metals, including stainless steel, aluminium (0·04 in. or 1·02 mm. minimum), copper, etc., in all positions and types of joints.

With the development of constant potential power supplies incorporating a drooping characteristic, it was found that surge currents could be controlled to limit the time duration of arc outages, prevent wire ejection, and produce a stable arc. This arc, operating in the range of 30 to 125 amp, 14 to 19 V, short circuits many times per second. This produces a small, rapidly-solidifying puddle pinpointing the location of the arc heat and enabling the welding of thin materials in all positions. It is used primarily with 0·03 in. (0·76 mm.) diameter wire, although 0·02 in. (0·51 mm.) diameter hard wire works well on material in the very low end of the thickness range.

Overhead welding with a Sigma ST-2 torch

Argon has been found suitable for most metals such as aluminium, copper and silicon-bronze.

Manual and mechanized equipment to feed wires as small as 0·02 in. or 0·03 in. diam. have been developed.

NEW LABORATORIES FOR RESEARCH INTO PROTECTIVE AND INSULATING ENAMELS

Coating Copper Wire

DEVELOPMENTS in electrical and electronic equipment are constantly producing demands for new properties in wire and in its insulation and protection, one example being that of the refrigeration industry, where some of the newer refrigerants are especially vicious in their attack on insulating coatings. Thus, producers of electrical wire are constantly seeking new formulations for their wire coatings.

For this reason, London Electric Wire Company Ltd., with an output of over 300 tons of enamelled wire per week, has established a new research laboratory, the Wildy Laboratory, at its Leyton works. The building makes available a further 12.000 ft^2 of working space for the development of wire coverings and wire covering plant, and includes a chemical research laboratory, an electrical research laboratory, a development and testing laboratory, drawing office, and a further laboratory specially equipped for the design and development of all types of wire covering machines and enamelling ovens and other plant.

The problems involved in insulating thin wires are more complex than at first appears. The wire is first covered with enamel which is reduced to a suitable thickness by a wiping device before the coated wire passes into the baking oven at a controlled speed. Oven atmospheres and temperature gradients are critical and must be accurately related to the type of coating applied and the nature of the service conditions to be encountered.

The chemical laboratory is equipped for the formulation of enamels and varnishes. In addition to original and development work, the laboratory is responsible for the tailoring of current enamels to suit the operating characteristics of production and experimental machines. This policy results in the closest possible control over production quality.

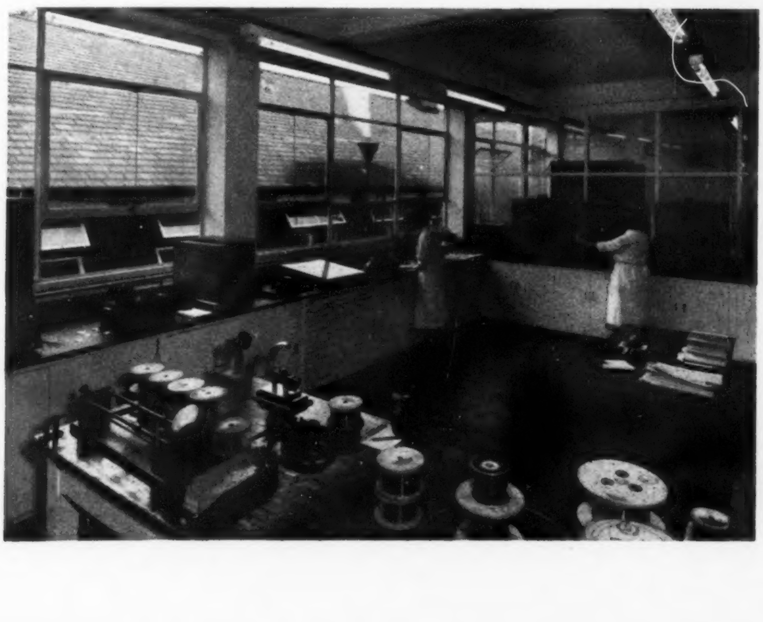
In the electrical laboratory, work includes the development of test methods and the evaluation of procedures that will ensure that current and newly-developed coverings will meet the changing and progressively onerous requirements of the electrical industry, for instance, the demand for higher operating temperatures.

Long-term thermal endurance testing is carried out in a battery of Baird and Tatlock ovens, some of the tests requiring up to a year for completion, since speeding-up of the process usually produces quite different conditions to those normally encountered in service.

Eccentricity of enamel coverings is a further concern of this laboratory, and a cable eccentricity gauge by Addison Electric Co. Ltd. is used for the examination of coatings. In order to ensure concentricity, freedom from pinholing, and maximum protection, it is customary to use 11 coats of enamel where synthetic enamels are used, although as few as six may be used with oil-based varnishes.

In the experimental testing laboratory, short-term ageing is carried out in Townson and Mercer ovens, and other tests include abrasion, electrical breakdown, solvent, and solvent plus pressure tests. For abrasion testing, the company has developed a machine which registers the number of cycles to breakdown — a requirement set by B.S.I., and the machine is being marketed to encourage other users and manufacturers to carry out their own testing.

Right: The electrical laboratory at the London Electric Wire Co. Ltd.



Below: Part of the experimental testing laboratory

The plant development laboratory, placed on the ground floor, is concerned with the building, testing and evaluation of ovens, coating and covering machines, and other equipment for use in the works.

The new building is in no way concerned with routine testing; it is essentially a research unit. Other laboratories at the Leyton works supervise and control the quality of, and processes involved in producing, the normal output of the factory.

Wire Drawing Efficiency

IMPROVED efficiency in wire drawing was achieved recently by Rist Cables Ltd., of Newcastle under Lyme, when they replanned the layout between their stores and wire drawing machines. According to an article in *Target*, the firm is the largest manufacturer of small flexible cable in this country, and over 100 coils of wire were used each day.

In the past, coils of wire were loaded on to a truck in the stores, hauled for 25 yards and unloaded on to the floor adjacent to each drawing machine. Two men were required to handle each coil.

The operator, servicing three machines, smoothed out any curls in the wire before it entered the machine. To do this, he needed as long a pay-out as could be managed, which took up still more space.

When the wire on a coil was nearing exhaustion, the operator joined it to the wire of the next coil by welding.

The new layout allows the wire to be fed direct to the machines from inside the stores by pulleys and guides, and through guide holes at about 8 ft. above floor level. The storeman is responsible for welding the wire off one coil to that of another. This has meant that the machine operators can now look after four machines instead of three as previously.

Fewer breaks occur in the wire, as the manhandling which caused distortion or damage to the coils has been obviated. The two men previously employed for an hour a day trucking the coils to the machines now give that time to other work.

Above: Part of the fine-wire drawing department, showing the feed tubes projecting from the wall on the right

Right: In the feed room an operator welds wire from one coil to that from another using a portable electric welder

Left: From the feed room, wire is reeled off "swifts," threaded through the wire guides and feed tubes (top right) to the wire drawing machines on the other side of the wall

A further saving has been made by getting rid of the oil tank and pump units which were formerly attached to each machine.

A 3,500 gallon tank is now positioned outside the factory wall, and the oil is carried by pumps to the machines. There is complete laboratory control of the oil mix, where formerly each operator was responsible for the viscosity of the oil, and added oil or water to his own mixture as he thought fit.

A Saturday morning shift which had to be brought in to clean up spilt oil has been dispensed with, and the oil in the tank is changed every six to eight months instead of every two months. Efficient filtering recovers 80 per cent of the oil, whereas previously all of it was lost. It is estimated that 20,000 gallons of oil a year will be saved.

The new layout occupies only 50 per cent of the space previously occupied and houses 20 per cent more machines.

Atomic Progress

Thermal Cycling Damage

IN the first article on thermal cycling damage (METAL INDUSTRY, 15 May 1959, p. 394) there was a discussion of the possible effects of alpha-beta cycling of uranium on fuel element performance. This article will consider some of the effects on uranium which arise from thermal cycling within the alpha phase. In particular, it will consider the phenomena of irradiation growth and the effect of alpha thermal cycling on creep rate.

Growth

When slowly cycled in the alpha temperature range, polycrystalline uranium specimens exhibit considerable distortion. The form of distortion is dependent on the structure developed during fabrication. Thus, the surface of an as-cast bar becomes roughened, usually called "wrinkling." Wrought bars, on the other hand retain a smooth surface but undergo marked increases in length. Usually, after the first few cycles, the proportional increase in length per cycle in fine grained highly textured uranium is constant. The amount of growth is greater the higher the upper cycling temperature and the longer the holding time at that temperature. For a given upper cycling temperature, growth per cycle increases with the cycling temperature range and is greater for slow heating and rapid cooling. Chiswick and Kelman[1] have also shown that the growth per cycle is greater the heavier the reduction and is greater for a given reduction at 300°C. than for higher working temperatures in the alpha range. Growth is also more extensive the finer the grain size.

Mechanism of Growth

Pugh[2] lists three basic factors which lead to the growth of wrought uranium bars on thermal cycling: (1) anisotropy of thermal expansion of α—uranium single crystals (2) the presence of a double fibre texture, the component textures having different coefficients of expansion along the axis of the bar, and (3) a change in mode of deformation with temperature.

The orthorhombic alpha uranium structure is markedly anisotropic, its coefficients of thermal expansion between 0° and 550°C. are:-

along the "a" axis $+33{\cdot}24\times10^{-6}$
" " "b" " $-6{\cdot}49\times10^{-6}$
" " "c" " $+30{\cdot}36\times10^{-6}$

In wrought uranium bar the observed double textures have consisted of an [010] fibre texture component while the other component may have (110) planes perpendicular to the bar axis. Such textures satisfy the requirements for growth. Other anisotropic metals do not exhibit growth because unsymmetrical double textures are not formed by working.

For growth to occur, the modes of deformation must change within the range of thermal cycling, otherwise the deformation on cooling would reverse that produced on heating. Pugh[2] shows that on heating there is little deformation until the upper holding temperature is reached, the internal stress is then relaxed by a thermally-activated process probably consisting mainly of slip on planes which do not operate at room temperature. A small amount of relaxation may occur by grain boundary flow, but none has yet been detected experimentally. During cooling, slip and twinning occur between 350° and 0°C., this leaves the aggregate stressed internally and these stresses are relaxed on the next heating cycle.

Pugh[2] analyses the results obtained by Chiswick and Kelman[1] using the method adopted for creep by Dorn.[3] In this way an activation energy of 65± 10 k cal/gm. atom, is obtained which is in good agreement with values obtained from self diffusion experiments.

During irradiation, "wrinkling" or "growth" can occur in suitable specimens in a manner resembling that obtained during thermal cycling. Alpha cycling can be a useful tool in assessing the likely stability of fuels during irradiation, even though the detailed mechanisms of growth differ. Beta-quenched uranium has an almost random fine grained structure; it therefore shows little growth or wrinkling. The effect of variations in heat-treatment can be assessed by alpha thermal cycling to determine the extent of slight residual preferred orientations. Variations in the extent of preferred orientation across a bar and along a bar are also revealed in suitably-designed experiments. In fact, levels of preferred orientation which cannot be detected reliably by X-ray techniques can be shown up in thermal cycling tests.

Effect on Creep Behaviour

Thermal cycles within the alpha range can affect the deformation of uranium. For example, large amplitude cycles may lead to plastic deformation of specimens loaded externally within the elastic range and which would, under isothermal conditions, show no plastic deformation. This effect is possible because the anisotropic character of uranium will cause the generation of internal stresses in the polycrystalline aggregate under the action of thermal cycles. The mechanism is similar to that involved in irradiation creep. Large thermal cycles also accelerate the creep rate of specimens undergoing creep in the normal way. An example of this is quoted by McIntosh and Heal.[4] Two specimens were creep tested at 400°C. and 3 tons/in^2 for about 1,700 hr. to establish the secondary creep rate. The specimens were then unloaded and the temperature allowed to fall to 100°C. After 8 hr. the test was resumed at 400°C. and 3 tons/in^2. This treatment was repeated at intervals of 4 days. The results shown graphically by McIntosh and Heal, indicate an acceleration in creep rate by approximately a factor of 4 for this type of cycling. The form of curve shown suggests that each thermal cycle leads to a significant increment of strain, in some ways comparable with primary creep, after which the creep rate settles down again, possibly returning to the rate which obtained before the thermal fluctuation. This behaviour is presumably due to the creep process relaxing out the internal stresses which are then regenerated at each successive thermal cycle. On this basis, increasing the frequency of cycling should give further accelerations of the creep rate and this is confirmed by McIntosh and Heal.

Small thermal cycles of the order of 5-10°C. have also been shown by Anderson[5] to cause an acceleration of the creep rate when "n" the stress index, in the creep law $\dot{\epsilon}=\sigma^n$ is greater than 1·0. McIntosh and Heal[4] quote experimental results in comparison with the calculated acceleration based on Anderson's theory. These are given

TABLE I—ACCELERATION OF CREEP RATE

Applied Stress tons/in^2	10°C. cycles (500°-480°C.)		5°C. cycles (500°-490°C.)	
	$\dot{\epsilon}_1/\dot{\epsilon}_2$ experiment	$\dot{\epsilon}_1/\dot{\epsilon}_2$ theory	$\dot{\epsilon}_1/\dot{\epsilon}_2$ experiment	$\dot{\epsilon}_1/\dot{\epsilon}_2$ theory
0·20	6·39	6·91	—	4·26
0·30	4·66	5·21	2·65	3·20
0·75	2·41	2·74	1·82	1·69

$\dot{\epsilon}_1$ = *creep rate with thermal cycling* $\dot{\epsilon}_2$ = *creep rate at 500°C.*

in Table I and show remarkably good agreement.

These results indicate an increasing acceleration of creep rate with decrease in external applied load for a given thermal cycling amplitude (the actual creep rate, of course, decreases with decrease in load), and also the smaller the thermal cycling amplitude for a given applied load the smaller the acceleration in creep rate. At 500°C. for a thermal cycle of 2°C. amplitude the theoretical increase in creep rate is fivefold for an applied stress of 100 lb/in^2. This serves to indicate that, in low stress creep tests in particular, it is of vital importance to apply the most stringent temperature control and the need for care in comparing results obtained from different equipment or different laboratories.

Very little has been published in the open literature on the effects of thermal cycling during irradiation. This may possibly be due to the fact that in many cases it may be difficult to separate irradiation effects from thermal cycling effects. There is some evidence that thermal cycling aggravates swelling due to fission product gases but it does not seem to be clear whether alpha phase cycling during irradiation will have this effect, or whether excursions to higher temperatures are necessary.

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1 H. H. Chiswick and L. R. Kelman; "Proc. of Int. Conf. On Peaceful Uses of Atomic Energy" (Geneva) 1956, **9**, 147.

2 S. F. Pugh; *J. Inst. Met.*, 1958, **86**, (12), 496.

3 J. E. Dorn; "Creep and Fracture of Metals at High Temperatures," (H.M.S.O.), 1956, 89.

4 A. B. McIntosh and T. J. Heal; Geneva Conference Paper. A/Conf.15/P/49. 1958.

5 R. G. Anderson; IGR-TN/C854.

Pumping Molten Aluminium

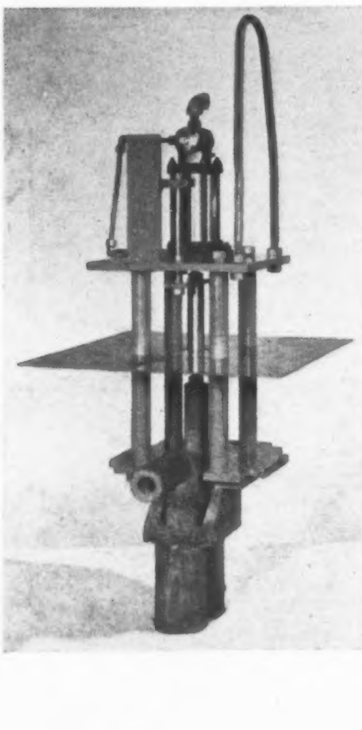
CONSTRUCTED entirely of "Refrax" refractory, a positive-displacement pump designed for handling molten aluminium has been developed, and tests indicate successful use with die-casting machines, for continuous casting, and in filling small ingot moulds. With further developments, this type pump might well be used in other non-ferrous metal handling operations.

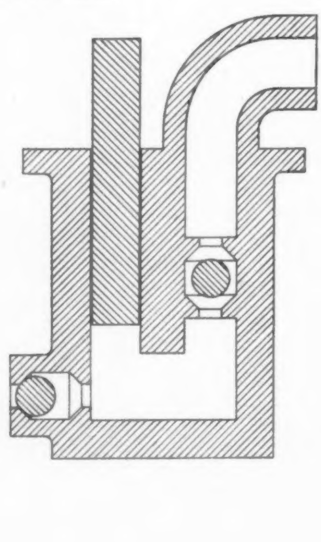
A primary advantage of the pump is that its parts are not wetted by molten aluminium and are unaffected by its highly corrosive action. Metal that is allowed to solidify can be easily stripped from exposed areas. Internal deposits simply melt when the pump is at operating temperature.

The distinctive properties of the refractory, a product of the Carborundum Company, that make possible the construction of this pump are high strength, exceptional dimensional accuracy obtainable in producing precision parts, smooth, metallic-like surface finish and excellent resistance to wear.

Left: The operating assembly of the positive-displacement pump made from "Refrax" refractory. An air cylinder (top) operates the piston, only the lower section of the pump being immersed in the molten aluminium

Below: Arrangement of pump. The inlet is at lower left, the outlet is the curved section at the top. The ball-type valves are of accurately-pressed refractory





Men and Metals

In succession to **Mr. R. F. Farmer**, who has resigned to take up an appointment with the Institute of Civil Engineers, **Mr. G. J. Lyons** has been appointed secretary of the Institution of Plant Engineers, and took up his duties on Monday last, September 21.

It has been announced by Brayshaw Furnaces Limited that **Mr. A. Moore** has been appointed area technical sales representative for the company in the areas of Northumberland, Durham, Yorkshire, Leicestershire, Derbyshire, Northants and Lincolnshire. He will be resident in Leeds.

After more than 40 years with the group, **Mr. W. N. Sherlock** is to retire at the end of this month as director and secretary of Birmid Industries Limited and a number of its subsidiaries. **Mr. F. S. Taylor** has been appointed as secretary of the company in succession to Mr. Sherlock.

It is reported that **Mr. Maxwell I. Freeman** has been appointed a director of the Consolidated Zinc Corporation.

In succession to **Mr. W. W. Nicholas,** B.Sc., who has taken up a teaching appointment in Birmingham, **Mr. E. W. Tinsley,** B.Sc., has been appointed representative in the Midlands for Walker, Crosweller and Company Limited.

News from Crofts (Engineers) Limited concerns the appointment of **Mr. L. C. Blake** and **Mr. A. E. Peggs** as two additional representatives for the London area. Both these gentlemen have recently completed the company's training course at the main works at Bradford.

It has been announced by the Institute of Welding that **Professor R. N. Rykalin,** Dr. techn.sci., corresponding member of the Soviet Academy of Sciences, will be visiting the United Kingdom at the invitation of the institute and will lecture at the School of Welding Technology on September 29 and 30, and at the special meeting on Electro-Slag Welding on October 1 next.

Metal Statistics

IN the 1959 edition of *Metal Statistics* new tables have been added for production of primary cadmium, U.S. exports of cadmium, tentative specifications for refined secondary lead, world production of columbium (niobium)—tantalum concentrate, and a comparison of Russian and United States mineral output. The usual data on world production, U.S. exports and imports, prices and consumption of almost all the ferrous and non-ferrous metals are included as in previous years. Published by American Metal Market, 18 Cliff Street, New York 38, N.Y., this fifty-second edition is priced at $3·50.

Reviews of the Month

NEW BOOKS AND THEIR AUTHORS

SHEET METALWORKING

"Sheet Metal Work." (Part II.) *By R. G. Blackburn and J. Cassidy. Published by Edward Arnold (Publishers) Ltd., 41 Maddox Street, London, W.1. Pp. iv + 221. Price 10s. 6d.*

THE necessity for a thorough education of apprentices has been particularly emphasized in recent years and there is not the slightest doubt that a popular book on a given subject is most important. "Sheet Metal Work" has been designed and written by two lecturers to meet the need of young apprentices taking up sheet metal work examinations of the City and Guilds of London Institute. The book will supplement their class instruction by further study at home. The book will also meet the need of students who are taking other trade courses in engineering, such as foundry work, and welding.

There is nothing original in this book, nor can it be expected that such a book be an original work, or that two lecturers could combine new thoughts on a subject of this kind. Nevertheless, credit must be given to those who take the advantage to be gained in grasping the ideas and suggestion of others and apply them to useful purpose. However, other people's ideas need not be slavishly followed. They must be, if necessary, altered to suit the particular need—they must not mislead.

Calculations with simple instruction in the use of logarithms, graphs and trigonometry will be very helpful to the first and second year student; there are some good examples in the measurement of plane figures, followed by a well-balanced introduction to the theorem of Pythagoras and applications of mensuration.

The subject of science occupies only 16 pages; most inadequate. The unit of force is given in pounds or tons, without any mention of grams or kilograms, which the student must meet sooner or later. The subject of heat is disposed of in about half a page of text on which an illustration of a vernier height gauge occupies almost the other half. Another page is taken up with the constitutional diagram and microstructures of the lead-tin alloys and typical cooling curves, while less than a full page is devoted to the subject of corrosion, protective coatings and prevention of corrosion. Albeit a little lopsided, the subject matter is well introduced to the student for which the book is intended.

Credit might be given to the authors for the section on Processes and Practice; though they should be more cognizant with the science of metallurgy before they advise their students on how to remove "these internal stresses (caused by cold work) by a process known as annealing." To remove cold work stresses there is no need to heat the sheet to 900° + 30°C. The cold worked material may be "process annealed" or stress relieved at a very much lower temperature without causing the job to be severely scaled as would be the case if heated to the high temperatures advised by the authors.

The book contains some good exercises and problems with answers, to help the student in his home study.

D. Ll.

FOUNDRY PRACTICE

"Modern Foundry Practice." *Edited by E. D. Howard. Published by Odhams Press Ltd., Long Acre, London, W.C.2. Pp. 464. Price 30s.*

IN the past 16 years this book has become the standard work in English for foundry students, and the third edition which is now reviewed is, in all respects, a worthy successor. It is refreshing to read a text book obviously based upon British practice when so many of the alternatives are designed for the American market. The present edition is substantially larger, and some new material has been added. Castings inspection and training for the foundry industry are now included in appendices, and the many technical developments which have taken place in the foundry industry during the past twenty years are given adequate consideration.

The errors are remarkably few, and this is no doubt due to the specialized nature of the contributions made. The illustrations are excellent and the generous use made of line drawings is commendable. Some consideration of investment moulding methods, and of die-casting techniques, could usefully have been included. Paper, binding and indexing have all been improved, and this useful text book can be recommended to all students of castings production.

J. B. McI.

BRAZING AND WELDING

"Filler Metals for Joining." *By Orville T. Barnett. Published by The Reinhold Publishing Corporation, New York; also by Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Pp. xi + 244. Price 56s. 0d.*

"FILLER Metals for Joining" presents the reader with data to select the correct filler metal for joining any particular metal or weldments. Unfortunately, it is based entirely on American standard specification and procedures. The writer has taken great care to have his book reviewed by some hundred experts in the welding industry to ensure that the text and data are an asset to those requiring information on the best "filler metal" for joining steel, cast iron, aluminium, copper and nickel metals and their alloys.

The early chapter illustrates the American methods of classifying electrodes and filler rods. The relationship between the filler rod and the strength of the weld metal deposited together with the type of coating on an electrode is very simply described. For example, the E6010 type of electrode indicates that the figures "60" suggests that the deposited metal will give 60,000 lb. tensile strength; the third figure "1" suggests that the electrode is suitable for "flat" welding, and the fourth figure "0" indicates that the coating has a high cellulose-sodium bond. In contrast, the fourth figure of 1, 2, 3, 4, 5 or 6 would indicate cellulose-potassium bond, titania-sodium, titania-potassium, low-hydrogen-sodium or low-hydrogen-potassium coatings respectively.

The use of brass, nickel and Monel metals for the welding of cast iron receives attention.

The types of alloys to use with the inert-arc processes for the welding of aluminium and its alloys are discussed. The minimum and maximum thickness of parent metal when using the Mig, Tig, gas, metallic-arc or hydrogen processes, and their relative value for such thicknesses, are noteworthy. The value of Mig welding over the Tig welding process, which eliminates the use of the tungsten electrode problems and has greatly increased the speed of welding aluminium is emphasized; Mig welding also reduces the cost and increases the X-ray soundness of the deposited metal.

The section dealing with filler metals for copper and copper alloys to be welded by gas or by the arc processes is interesting and valuable. The author suggests that the Mig welding process is the first choice for the welding of copper. The rod should be manufactured from deoxidized copper and may contain one or more of the following elements: phosphorus and silicon, with some manganese and tin to improve soundness and strength. Fluidity of the weld metal may be increased with the addition of 1 per cent silver.

For the welding of nickel and nickel alloys, the filler metal may contain titanium with advantageous results for all processes. There is an excellent chapter on hard surfacing of metals with some nine pages of tables showing chemical compositions of hard surfacing electrodes and materials. Instructions on prolonging the life of tungsten electrodes used for inert-arc welding are a valuable asset. The chapter on brazing is interesting and offers some excellent data regarding the functions of brazing

filler metals, their classification and their composition.

This is an excellent reference book on American filler metals for all joining processes. A similar book, giving data of British Standards and classifications would be of great importance to the welding industry.

I. W.

METAL FINISHING

"Jahrbuch der Oberflächentechnik 1959." (*Yearbook of Surface Treatment Practice* 1959.) *Edited by W. Wiederholt. Published by Metall-Verlag G.m.b.H., Hubertusallee* 18, *Berlin-Grunewald. Pp.* 1,100. *Price DM.* 22·50.

ALTHOUGH the literal translation of the German "Jahrbuch" is, in fact, "Yearbook," a modified and expanded title such as "Annual Report on Progress in Surface Treatment Practice" would be much more descriptive of the nature of the contents of this publication. The successive issues of a "yearbook" tend to undergo the least possible change, year-in, year-out, whereas an "annual report on progress" must necessarily change with developments in the field with which it is concerned, and such developments in the field of surface treatment are both numerous and rapid.

The "Jahrbuch" under review adopts a number of ways and means to accomplish this task of reporting on roughly a year's (1958) progress in surface treatment practice. To begin with, there are numerous review articles contributed by specialists on various topics of recent and current interest. A few of these quoted at random—fatigue strength and the surface finish of metal parts, the use of ion exchange materials in surface treatment practice, corrosion protective packaging for transport by sea, progress in ultrasonic cleaning, corrosion inhibitors for metals as reflected in the patent literature, surface treatment of stainless steels, the surface treatment of magnesium alloys, the modernizing and mechanizing of plating shops, the recrystallization of electrodeposits, internal stresses in nickel deposits, the continuous silver plating of wire, the bulk zinc plating of small parts by the "Mitral" (peen plating) process, and the use of radioactive isotopes in surface treatment practice—provide ample evidence of the editorial skill shown in selecting subjects of topical interest. By avoiding repetition from year to year, these review articles are intended to add up to a comprehensive compendium of information on the whole field of surface treatment, though, unavoidably, effects of age will make themselves felt with the passing years.

To correct this, and to enable readers to acquaint themselves with all the latest developments in the art and science of surface treatment, the "Jahrbuch" follows up with articles (annotated bibliographies) surveying the 1957-1958 "literature" on surface treatment. Separate articles survey, respectively, the scientific and technical literature, the German patent literature, German, British and U.S. standard specifications relating to surface treatment, and the trade and commercial literature. So much for reports on progress, which occupy about 3/5ths of the book.

There follows largely tabulated data on the composition and operating conditions of a very wide range of surface treatment baths, solutions, etc. and of miscellaneous information relating to, or of interest in connection with surface treatment, the latter comprising tables, lists, flow-sheets, etc., taken from recent journal articles and other publications; finally, there are a subject index, a list of Trade Names, and a classified list of suppliers to the trade.

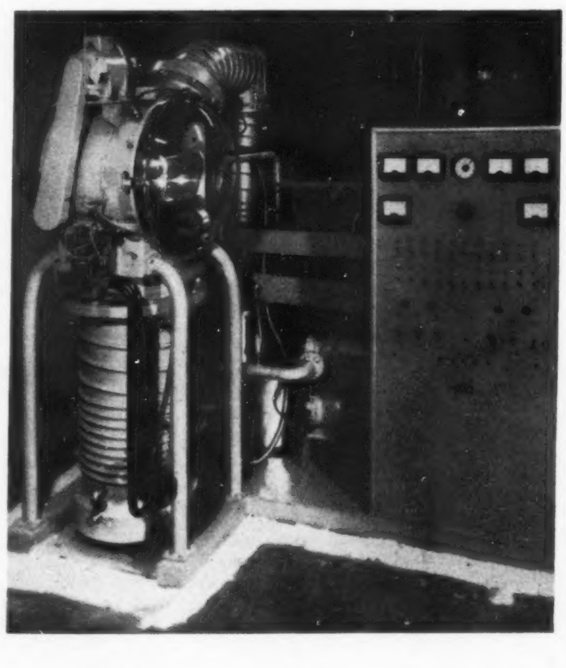
Although, strictly speaking, a 1959 yearbook published at the beginning of the year should have been reviewed much earlier, it is hoped that the review will have succeeded in conveying the impression that the contents of the publication are such that readers seriously concerned with surface treatment and who can read German will certainly find it worth while purchasing a copy. Indeed, an incidental advantage of doing it now is that they will then not have to wait quite so long for next year's edition.

A. B.

Vacuum Metallized Thin Films

A METALLIZED finish on paper or plastics that is claimed to be superior in appearance to aluminium foil laminate and at about half the cost can be produced in a machine developed by Vacuum Metallurgical Developments Ltd., Shelford, Cambridge. Materials that can be metallized at the machine's top speed of 800 ft/min. include friction glazed, lacquered and embossed papers, cellulose (viscose) film, cellulose acetate, polythene, terephthalate (Melinex-type), polyvinyl-chloride and pliofilm; most common packaging papers and plastics can be coated, including glassines.

With the V.M.D. metallizer it is not necessary to dry the base material before treatment. This eliminates a costly operation and avoids deterioration of quality that accompanies degassing or drying. The base material is in reels 12 in. or 30 in. wide, and 12 in. or 18 in. diameter. These are loaded into the vacuum chamber. In travelling through the machine, the web passes to a take-up roll through an intense source of aluminium vapour which condenses upon the surface of the web. The 12 in. machine will metallize at a cost of 0·016 pence/ft^2. Although the manufacturers do not claim that the process is a moisture barrier in competition with aluminium foil they do, however, claim that the process has a decorative effect comparable with that of aluminium foil and in many applications better than that material, with an appropriate saving in cost.



The vacuum deposition machine for the production of thin metallic films on a variety of materials. The machine is produced by Vacuum Metallurgical Developments Ltd.

Industrial News

Home and Overseas

Silicones in Welding

A patent recently published in the name of **Midland Silicones Ltd.,** British Patent No. 817699, describes the use of silicone pressure sensitive materials in welding. A weld backing assembly, consisting of glasscloth impregnated and coated with a silicone pressure sensitive adhesive, to which is attached a flexible steel tape on one side, firmly adheres to the workplaces. After welding, the weld backing is easily stripped off and the residual ash brushed off. An excellent smooth weld is produced and no grinding off of excess material is needed. Other assemblies are described, including one comprising alternate layers of heavy aluminium foil and pressure-sensitive silicone adhesive. It is thought that the invention will be particularly useful where irregularly-shaped and curved surfaces or pipes are to be welded.

Lead and Zinc Investigation

Following a Senate resolution, the United States Tariff Commission has instituted an investigation of the domestic lead and zinc industry under the authority of Section 332 of the Tariff Act of 1930.

The Commission is required to bring up to date the report previously made following a similar investigation in 1953-4. The new report is also to include specific findings with regard to the current condition of the lead and zinc mining industry, and as to what additional import restrictions, if any, need to be imposed on certain items in order that lead and zinc mining operations in the U.S.A. may be conducted on a sound and stable basis.

A public hearing, at which all interested parties may appear and be heard, is to be held in Washington in January next. Among the items subject to investigation are zinc fume or zinc flue dust, zinc wire, lead-bearing flue dust, mattes and ores of all kinds, lead in bars and pigs, antimonial scrap lead, lead in sheets and pipe, zinc bearing ores of all kinds, zinc in blocks, pigs or slabs, zinc alloys and lead and zinc mill products.

Chemical Company's New Factory

On Thursday of last week, the new works and offices of the **Reddish Chemical Company Ltd.,** at Cheadle Hulme, were officially opened by Professor H. D. Kay, C.B.E. The company have been specialists in the manufacture of chemical detergents for 30 years, supplying to the milk, food and beverage industries, the engineering trades and to farming. With these activities, coupled with close liaison with ministerial groups and their respective research establishments, the company has achieved a high reputation for its products.

With its expansion year by year, the company is turning its attention to new fields and with the increased facilities at its disposal it now proposes to operate new activities outside the present coverage. Next month their new subsidiary—Reddish Detergents Ltd.—will commence to operate and will include a degreasing section for the metal finishing industry.

The new works and offices have been built on a $3\frac{1}{2}$ acre site in the recently developed industrial area at Cheadle Hulme. The factory itself has a floor space of 16,500 ft^2 with a separate office block of more than 2,000 ft^2. Allowance has also been made for considerable expansion of works and offices in the future, as well as for storage facilities and lorry accommodation. Our photograph on this page shows laboratory assistants at work on quality control and development.

A Removal

It is reported that **Acme Conveyors Ltd.** have now completed the transfer of their detail design, buying and accounts departments, to their office extension situated at 56-82 Seaward Street, Glasgow, S.W.1. The technical sales and projects departments of the company will continue to be administered from Acme Chambers, 1 Bradford Street, Walsall, Staffs. Acme Ventilating Ltd. will continue to operate also from the Walsall offices.

An Event in Germany

A Symposium on hardening techniques and heat-treatments is to be held in Wiesbaden, Germany, on October 20-21 under the auspices of the Institut für Háterei-Technik. The Symposium will be preceded, on October 19, by a discussion on new processes in induction heating for hardening and heat-treatment. Details of the arrangement can be obtained from the Institut für Hárterei-Technik, Bremen-St. Magnus, Postfach 13, Germany.

Aluminium Smelter for Ghana

It has been reported from Accra that Mr. Edgar Kaiser, chairman of the Kaiser Aluminium and Chemical Corporation, has agreed to a proposal by Premier Nkrumah that the company should take the initiative in forming a consortium of aluminium companies to build a smelter near Tema, east of Accra, as part of Ghana's Volta River project. An official announcement said the Prime Minister hoped to "receive a firm proposal from Mr. Kaiser before the end of the year."

It is understood that Kaiser Aluminium has already held some exploratory talks with a number of foreign aluminium producers, Canadian aluminium interests, as well as Italian, British and French companies, are reported to be interested. The proposed aluminium plant would have an annual capacity of 220,000 tons.

The Volta River project, Ghana's biggest single industrial project, envisages the building of a dam on the Volta River and installations to feed power not only to the planned aluminium smelter but also to other industries which, it is hoped, will grow up in the area in the future.

Die-Casting in U.S.A.

According to the American Die-Casting Institute, aluminium de-casting production this year will rise about 34 per cent from a year ago, while zinc die-casting production will increase by 23 per cent. The institute estimated 1959 zinc casting production would reach 310,000 tons by the end of the year, up 58,000 tons from a year ago. Aluminium die-casting output is estimated at 390 million lb., up from 290,250,000 lb. in 1958. A spokesman for the Association said the increases are resulting from a revival of demand from the automotive industry, the principal die-casting customer.

Copper Mining in Australia

According to reports from Tokyo, a Japanese copper mining survey team of three experts is visiting Australia to investigate the possibility of investing in copper mining at Ravensthorpe, in the south of Western Australia. The experts will conduct a one-month survey there, and this will be the first Japanese survey team sent to Australian copper mines. Japanese copper producers have been asked to invest about £159,000 in the Ravensthorpe Copper Mining Company's shares to aid the company's expansion programme.

Results of the survey are expected to lead to a decision by Japanese producers on whether the money should be invested in the Australian mine or advanced as a long-term loan. The industry has also decided to send another group of nine

Laboratory assistants at work on quality control and development, at the Reddish Chemical Company's works, Cheadle Hulme

Japanese experts and traders to South Africa in mid-October to inspect major copper mines in the country and conduct a survey of ore resources. Japan's growing requirements have necessitated the acquisition of more ore supplies. Hence the sending of these survey teams. The industry also eventually hopes to acquire ore supplies from South-East Asian and South American countries and Canada.

A New Factory

News from **Efco Limited** is that they are building a new factory in the L.C.C. industrial development area at Sheerwater, near Woking, in Surrey. The site is a prominent corner position close to the factory of their subsidiary, Electro-Chemical Engineering Co. Ltd. The new factory, scheduled for completion early next year, will provide up-to-date facilities for the manufacture of special furnaces.

Pedal Control

Recently developed for shop conditions, a pedal control has been introduced by **J. P. Udal Limited.** This unit is stated to greatly reduce the effort required to operate any machine and to help eliminate operator fatigue. Designed for easy toe operation, with the operator's heel resting on the floor, it can include either an air valve or an electric limit switch.

Another unit recently produced by this company is the I.G.E. patent "Saffail" valve, which has been designed so that there is five times the force available to move the operating spool from "on" to "off" than is available to move it from "off" to "on". This differential is checked electrically every operation, and when the differential drops, through any fault, the valve is locked "off" until the fault is rectified. For the control of electro-pneumatic power press clutches, the company has designed a control system around this valve which, they say, gives complete self-checking of all electrical circuits as well.

£2 Million Order

Contracts have been awarded to the **Head Wrightson Machine Co. Ltd.** for plant, valued over £2 million, for the installation of an electrolytic tinning line at the Ebbw Vale works of Richard Thomas and Baldwins Ltd., capable of tinning and re-coiling 1,500 ft. of steel strip per minute. This line will be built at Head Wrightson's works on Tees-side.

Additionally, equipment is being supplied for the preparation of steel strip before it is processed in the tinning line, for tin plate cut-up lines, and for equipment to inspect and assort the plate.

Delivery will be made in 18 months and it is being designed in collaboration with the Aetna Standard Division of the Blaw Knox Company of America, with whom the Head Wrightson Company have been associated for several years.

Metal Stocks

Stocks of refined tin in London Metal Exchange warehouses at the end of last week rose 23 to 8,560 tons, comprising London 4,839, Liverpool 3,561, and Hull 160 tons.

Copper stocks fell 1,850 to 12,813 tons, and comprised London 2,997, Liverpool 6,441, Birmingham 375, and Manchester 3,000 tons.

Welding Equipment

Planned by the Heating and Welding Department of the **A.E.I. Transformer Division,** a series of exhibitions and demonstrations have been arranged in various centres of industry. Their purpose is to provide an opportunity for all users and potential users of welding to see the latest types of equipment in operation.

Visitors and company officials watching a demonstration of submerged arc automatic welding at the recent Metrovick (A.E.I.) exhibition at Newcastle on Tyne

The first exhibition was held in Newcastle on Tyne during the first three days of September, on the premises of the Rutherford College of Technology, and the attendance emphasized the effectiveness of local demonstration. It is to be repeated in Birmingham (October 19-30) in the Midlands Electricity Board showrooms, Aston.

Equipment to be exhibited will include both resistance welding and arc welding sets. The resistance welding section will comprise air-operated spot welders, projection welders and butt welders. Among the arc welding equipment, an automatic arc welding machine, suitable for either open or submerged arc welding, will be demonstrated using the submerged arc process. Single—and multiple—operator A.C. welding sets, rectifier arc welding sets and inert-gas arc welding equipment will also be shown. Associated equipment will include a rope parting machine and a rivet heating machine. Using the A.C. "Thermac" welding set and the D.C. rectifier unit, test runs will be made using various Metrovick electrodes to demonstrate their qualities.

Emulsions

Commencing on Friday, October 30 next, a course of six lectures to be given by specialist lecturers on "The Production and Properties of Emulsions" will be held at the Borough Polytechnic, London, S.E.1. This course is intended for graduates and others engaged in industrial and paint laboratories. The fee for the course is ten shillings, and the lectures are to be given on Friday evenings from 6.30 to 9 p.m.

Research Organization

Under the auspices of Technical Platings Ltd., and Anodising and Platings Ltd., a new company has recently been formed with the title **Anodising Research and Development Organisation Ltd.** The object of the company, as its name implies, is to undertake further research and development work in connection with the field of anodizing.

The company will have access to experience accumulated since the inception of anodizing, and will also have the benefit of the laboratories of the two parent companies in Teddington and Radcliffe respectively.

A One-Day Conference

Details have been issued of a one-day conference organized by the **Central London Productivity Association,** and to be held on Thursday, October 22 next, entitled "Computers for the Smaller Firm." The conference will be held at the Council Chambers of the F.B.I., 21 Tothill Street, London, S.W.1, from 9.45 a.m. until 4.45 p.m.

Change of Address

We are informed by **The Northern Aluminium Company Ltd.** that their London area sales office has now removed from Bush House to new premises at 50 Eastbourne Terrace, London, W.2, with the telephone number of Paddington 3281.

A New Edition

Full information on the coal mining and allied industries is presented in a convenient and reliable form in the 37th edition of the Colliery Year Book and Coal Trades Directory. Information on coal production in Western Europe, the U.S.A., Poland and the U.S.S.R. has been shown as fully and accurately as possible. Full particulars of every coal mine in Great Britain are given, together with current information regarding the Ministry of Power and the National Coal Board, and the Mines and Quarries Regulations, 1956, with the 1958 amendments.

Covering 884 pages, this year book is published by Iliffe and Sons Limited, Dorset House, Stamford Street, London, S.E.1, at the price of 40s. (by post 42s.).

Building Exhibition

One of the interesting stands at the forthcoming Building Exhibition in London is that provided by the **Copper Development Association.** Representative of the extensive use of copper tube for all forms of plumbing services, a working model of a small-bore heating circuit will emphasize the particular suitability of copper tube for this type of system. The use of copper in sheet and strip form will

be demonstrated by an example of copper cladding on the facing of a large modern building. Evidence of the several new copper roofing techniques which have been developed will be provided by a display of copper-clad tiles.

Examples of weatherings and roofing details, copper rainwater goods, together with heating and plumbing fittings in copper or copper alloys, will make up a further display item. The design of the C.D.A. stand also serves as a reminder of the extreme decorative value of copper and its alloys, with a most striking effect being obtained by the use of satin finished copper, brass, nickel silver (nickel bronze), brown and black bronze, and green patina tiles.

Agents Appointed

It is learned that **Keelavite Hydraulics Limited** have appointed Holman Bros. (Pty.) Ltd., of Johannesburg, as their agent for the sale of hydraulic equipment in South Africa and Rhodesia. Holman Bros. are manufacturing hydraulic cylinders under licence from Keelavite.

Contract News

One of the largest electric heat-treatment furnaces in this country is to be built by **Birlec Limited**, for the English Steel Co. Ltd., at a cost exceeding £65,000. The furnace is of the pit type, with effective internal dimensions 35 ft. deep by 8 ft. diameter, and a rating of 1,220 kW.

Birlec have also received an order, valued at £22,000, for two special furnaces for annealing reactor fuel elements, from the United Kingdom Atomic Energy Authority, and an export order from Oy Vucksenniska Ab of Finland for an electric annealing furnace. The value of this order is £9,000.

Malayan Tin Production

According to figures issued in Kuala Lumpur, Malayan tin production in August totalled 67,606 piculs of tin-concentrates, containing 3,046 tons of tin metal based on an assay value of 75·7 per cent. July output amounted to 3,213 tons of tin metal. At the end of August, there were 38 dredges, 339 gravel-pump mines, and 43 other tin mines in operation, making a total of 420 active tin mines. The end-July figures were 40 dredges, 342 gravel-pump mines, and 47 others, making a total of 429 active tin mines.

Copper and Aluminium in U.S.A.

Usually reliable trade sources in New York state that only about 14 per cent of the monthly domestic copper mine output was not affected in any way by the strikes of the United Steelworkers and the Mine, Mill and Smelter Workers' Union. This 14 per cent represented 11,400 tons per month. The remaining 86 per cent—70,300 tons—was either not being mined or refined because of the strikes. Of the 86 per cent, nearly 68 per cent—55,300 tons—was not being mined at all. This output was completely lost, the metal remaining in the ground. About 18 per cent—15,000 tons—was being mined but, again, because of the strike was not being smelted or refined.

These monthly accumulations of 15,000 tons would be available for refining when the struck plants restarted. The sources said they had based their analyses on the 1958 production figures by domestic mines. There had been some variation in the 1959 output by some companies, but the differences, they thought, were not serious enough to affect the results.

The impact of the steel strike is now reaching the aluminium industry, and is adversely affecting the volume of key consumers of both steel and aluminium, according to the periodical *American Metal Market*. Earlier expectations that bookings and shipments would merely level off as a result of the strike are back-firing, the publication declared. Third-quarter aluminium business is now expected to drop below second quarter levels. The newspaper said in view of adequate aluminium supplies and capacity to produce, these users of steel obviously feel there is no need to lay in added supplies of aluminium, as long as no new steel supplies are available. The aluminium industry had expected to pick up late in the third quarter, which would extend over and gain momentum to make the fourth quarter a record period. This forecast, it added, will not be fulfilled unless the steel strike ends quickly.

Production Engineering

A new illustrated brochure, describing the opportunities available to boys entering the profession of production engineering, and entitled "A Career in Production Engineering," has just been published. This brochure will be of interest not only to school leavers and their parents, but also to technical colleges, training officers, youth employment officers and careers masters. Copies may be obtained, free of charge, from: The Institution of Production Engineers, 10 Chesterfield Street, Mayfair, London, W.1.

New Markets

Activity is reviving strongly in the great majority of the world's industrial nations, in many cases surging to new records. While most of the undeveloped countries are still suffering from the relatively low prices of the raw materials they produce, the beginning of the improvement in their position is being noted. Their foreign-exchange earnings should start increasing before long as the volume of their sales picks up in response to heightened activity in the industrial countries.

Some interesting notes in a recent issue of the *Board of Trade Journal*, contributed by H.M. First Secretary (Commercial) at Bahrain, draws attention to the Trucial States in the Persian Gulf as a potential market for British goods. What are known as the Trucial States is the territory which lies at the southern end of the Persian Gulf and covers an area of approximately 32,000 miles^2 extending along the coast eastwards from the base of the Qatar Gulf from the Gulf of Oman. The country is for the most part barren, and the majority of the estimated 86,000 population are concentrated in the coastal towns, of which Dubai, Abu Dhabi and Sharjah are the most important. Dubai is the main importing centre for the Trucial coast and imports in 1958 were £4,717,576. The Trucial States are said to be considerably poorer than the oil-rich states to the north, but it is stated that the opportunities for increased trade arise mainly from the expanding markets for the necessities of life in the States themselves. In this respect, metals of all kinds would appear to be concerned for among the demand for foreign goods are such items as water pumps, agricultural machinery, air conditioners, refrigerators, electrical goods, concrete mixers, lubricating oils, motor vehicles, diesel engines.

In 1958 it was announced that oil drilling operations had begun off Das Island, which belongs to Abu Dhabi and lies about 100 miles to the north-west of the town of that name. As a result of those operations it was considered that a satisfactory commercial development might take place, and this has since been confirmed by the fact that three oil-wells have now been drilled. A harbour development scheme at Dubai is also well on the way, municipal electricity undertaking, telephone systems and a new airport are also among the projects planned for this large area.

It is stated that the British Government has contributed towards various development works in these States and it would seem, therefore, that this is a future market well worth watching, and British exporters interested in cultivating this potential source of trade will find that the Commercial Secretariat of H.M. Political Residency at Bahrain and H.M. Political Agency at Dubai will be only too glad to answer questions on such possibilities of trade, and to help exporters to get in touch with suitable local merchants. With more and more forceful appeals for export trade, it is necessary for all branches of British industry, including the non-ferrous metals industry, to see to it that no opportunity is lost of improving the United Kingdom's economic position.

U.K. Trade in August

Statistics published in the last issue of the *Board of Trade Journal* show that exports and imports were lower in August than in July; some fall was to be expected as a normal seasonal movement. The visible trade deficit was smaller in August. United Kingdom exports in August were £255·4 million, compared with £287·8 million in July. As compared with the first quarter of the year, the monthly rate of exports in the five months April-August was 5½ per cent higher. Exports in January-August were 3 per cent higher than in the same period of last year.

Non-Ferrous Club

Resuming its luncheon meetings, the **Non-Ferrous Club** will meet again on Wednesday, October 7 next, at the Queen's Hotel, Birmingham, when the guest speaker will be Mr. E. N. Hiley, secretary of the National Brassfoundry Association, who will take as his subject "The City of London".

Forthcoming Meetings

September 25—Institute of Metal Finishing. Sheffield and North-East Branch. Department of Applied Science, Sheffield University, Mappin Street, Sheffield, 1. "Trisec" Metal Drying Process (and demonstration). G. Yeats. 7 p.m.

September 28—Association of Bronze and Brass Founders. Yorkshire Branch. The Great Northern Hotel, Leeds. Luncheon. Followed by installation lecture on "Costing a Casting". 12.15 p.m. for 1 p.m. luncheon. Lecture at 2.15 p.m.

September 30—Association of Bronze and Brass Founders. Scottish Branch. The St. Enoch Hotel, Glasgow. Meeting of members at 12 noon, with luncheon at 1 p.m. Followed by installation lecture on "Costing a Casting" at 2.30 p.m.

October 1—Institute of Metals. Birmingham Local Section. College of Technology, Gosta Green, Birmingham. "Metallurgical Information". B. Fullman, M.B.E., F.I.M. 6.30 p.m.

Metal Market News

THE usual monthly statistics appeared last week, published by the Copper Institute, for August and they show, as might be expected, a sharp contraction in the United States tonnage, production being particularly affected. Details, given in short tons of 2,000 lb., are as follows: Inside the United States, production of crude copper dropped from 89,985 tons in July to 57,206 tons in August, while in the case of refined the comparison was 134,020 in July and 79,860 last month. Deliveries also declined, the comparison being 108,127 tons in July and 89,123 tons in August. Stocks were reduced, but not very seriously, for the August total of 92,175 tons compared with 103,432 tons a month earlier. Outside the U.S.A. there was a marked increase in the deliveries to consumers, which advanced from 123,011 tons in July to 148,121 tons in August. Output of refined copper was about 1,000 tons up at 141,877 tons, while in crude the August figure of 181,114 tons compared with 175,942 tons in July. Stocks of refined copper in producers' hands were about 4,000 tons down at 282,344 tons. July appears to have borne the brunt of the adverse effect of the annual holiday on consumption, for the figures covering that month, issued by the British Bureau of Non-Ferrous Statistics, show a serious setback in comparison with June. In copper, for example, the July total of refined copper was 32,034 tons, against 44,761 tons, but secondary was 2,000 tons up at 13,394 tons. Stocks were 1,625 tons up at 81,986 tons. In lead, consumption was 26,851 tons, against 30,099 tons, and stocks were 67,586 tons, against 57,810 tons. Usage of zinc dropped by 3,900 tons to 26,318 tons, while stocks of refined zinc, at 37,427 tons, compared with 38,297 tons. Consumption of tin dropped back by 305 tons to 1,682 tons.

Trading in standard copper was active at 12,250 tons, and the market at the close looked rather weak at £225 for cash, although earlier in the week the price was a good deal lower. Conflicting reports about negotiations between the Anaconda company and the Mine Mill Union caused ups and downs, both on Comex in New York and in London. The week opened about £4 below the previous Friday, with cash at £229 15s. 0d. and forward at £230 15s. 0d., the emergence of a contango being a welcome development. On the afternoon session, however, a report that the Union had asked Anaconda to agree to a bargaining session caused a collapse, and three months was traded at £222. The close, however, was £228 cash and £228 10s. 0d. three months; £229 was understood to have been paid on the Kerb. Unsettled conditions filled in the balance of the week but the trend was downwards. Finally, the close was £225 cash, £8 15s. 0d. down, and £226 10s. 0d. three months, which showed a loss of £6 15s. 0d. During the week a reduction was made in the Belgian price. Metal Exchange stocks suffered a loss of 300 tons to 14,663 tons.

Stocks of tin in official warehouses were reported at the beginning of last week to be 228 tons up at 8,057 tons. Trading on the market was rather quiet and cash closed unchanged at £793 10s. 0d., but three months gained £1 to close at £794 10s. 0d. A contango of £1 was therefore established, which was a satisfactory development. Both lead and zinc were rather easier, and although a fairly optimistic view is taken of the price prospects for these two metals during the coming months, their advance seems to be halted for the present. September lead was marked down by 10s. to £70 15s. 0d., while December lost 7s. 6d. to close at £72. The closing quotation in zinc for the current month was £86, a drop of 15s., while December lost 7s. 6d. at £85 2s. 6d.

Birmingham

Expansion seems likely to continue in the metal industries of the Midlands during the last quarter of the year. Although electioneering influences may be noticeable in the near future, it seems unlikely that this will affect the general trend. Rolling mills and foundries are supplying more sheets and castings in non-ferrous metal to a variety of trades, foremost among which is that of motor cars and components. The electrical industries are also actively engaged in both light and heavy equipment manufacture. Exports have risen slowly as compared with a year ago, leaving aside the usual lull in the August holiday period. Demand for domestic appliances continues on the increase.

Confidence is growing in the iron and steel industry, and the belief is that demand will soon justify surplus capacity being brought back into commission. So far, pig iron supplies have been ample to supply the needs of foundrymen, but it may be that idle furnaces will be relighted in the coming quarter. Re-rollers are experiencing much bigger demands for their products, and this has brought a corresponding increase in the call for semi-finished steel. Demand for raw materials for the machine tool industry is on the increase.

New York

Commodity Exchange copper was easy over the week-end on active liquidation, declining by about half a cent per lb., reflecting reports that Kennecott and the Mine Mill Workers' Union were to resume negotiations next week, traders said. Meanwhile, dealers reported a softer undertone to copper. Dealer offerings below 33 cents were meeting meagre buying interest from consumers. American Metal Climax reported some business at 33 cents. Scrap copper was off half a cent. Tin was quiet and steady. Lead was moderately active. Zinc sales were quite active, according to at least one leading seller.

After the end of the steel strike it is expected there will be a sharp rise in the use of nickel to make up for the many weeks of loss in melting at many alloy steel plants. But, in view of high inventories plus the new nickel capacity coming in, there is no reason to expect price increases within the foreseeable future. These are the views of Mr. Albert W. Gudal, Lukens Steel Company analyst, published in the latest bulletin of the National Association of Purchasing Agents.

The U.S. is putting the Government-owned Nicargo nickel plant in Cuba up for sale. The General Services Administration announced it would receive purchase proposals until the close of business on December 1. The United States has invested about 85 million dollars in the plant located in Cuba's Oriente province, about 460 miles from Havana. G.S.A. said the plant has a proven production capacity of 50 million lb. of nickel oxide powder and sinter per year. The agency has been operating the plant since it was reactivated in 1952.

Guinea

News from Paris is that the International Company for the Production of Aluminium should come into production in Guinea early next year. The railway from Fria to Conakry has now been completed. It will be remembered that the company is financed by American, French, British, Swiss and German capital, but the direction is French. The administrators have made it quite clear that the political changes have not produced any difficulties in the country.

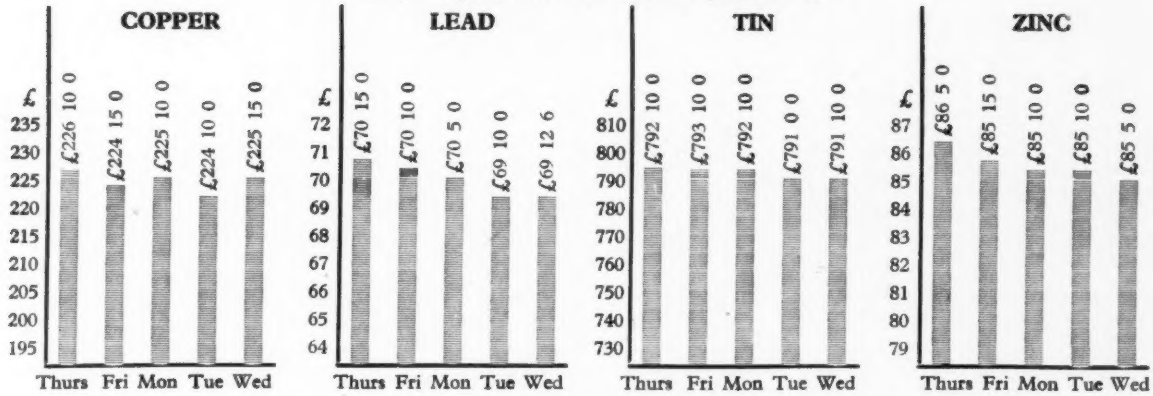
The three phase plan, prospection, construction and exploitation of the whole project are said to be all up to schedule.

The World Bank has granted a 35,000 dollar loan for the construction of 290 kilometres of overhead cable, and also a railway line for the transport of manganese from Mouana to Pointe Noire in the French Gabon. This will also aid the transport of uranium mined at Mouana by the Société des Minerais d'Uranium de Franceville. The uranium and manganese mines are adjacent to each other.

Non-Ferrous Metal Prices

London Metal Exchange

Thursday 17 September to Wednesday 23 September 1959



Primary Metals

All prices quoted are those available at 2 p.m. 23/9/59

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		9	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		14	0
Columbite.... per unit			—	
Copper H.C. Electro	ton	225	15	0
Fire Refined 99·70%	„	224	0	0
Fire Refined 99·50%	„	223	0	0

		£	s.	d.
Copper Sulphate	ton	76	0	0
Germanium	grm.		—	
Gold	oz.	12	10	4½
Indium	„		10	0
Iridium	„	24	0	0
Lanthanum	grm.		15	0
Lead English	ton	69	12	6
Magnesium Ingots	lb.		2	3
Notched Bar	„		2	9½
Powder Grade 4	„		6	1
Alloy Ingot, A8 or AZ91	„		2	4
Manganese Metal	ton	245	0	0
Mercury	flask	71	10	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	

		£	s.	d.
Palladium	oz.	7	5	0
Platinum	„	28	10	0
Rhodium	„	41	0	0
Ruthenium	„	18	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	7
Tellurium	lb.		15	0
Tin	ton	791	10	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	84	15	0
Dust 95/97%	„	114	0	0
Dust 98/99%	„	120	0	0
Granulated 99+%	„	109	15	0
Granulated 99·99+%	„	123	2	6

** Duty and Carriage to customers' works for buyers' account.*

Foreign Quotations

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg	≏£/ton	Canada c/lb	≏£/ton	France fr/kg	≏£/ton	Italy lire/kg	≏£/ton	Switzerland fr/kg	≏£/ton	United States c/lb	≏£/ton
Aluminium			22.50	185 17 6	224	168 0	375	221 5	2.50	212 10	26.80	214 10
Antimony 99.0					230	171 10	445	262 10			29.00	232 0
Cadmium					1,300	975 0					120.00	960 0
Copper												
Crude												
Wire bars 99.9							455	268 10				
Electrolytic	31.50	231 17 6	29.00	238 12 6	315	236 5 6			2.75	233 17 6	30.00	240 0
Lead			10.75	88 12 6	102	76 10	165	97 7 6	.88	74 17 6	13.00	104 0
Magnesium												
Nickel			70.00	578 5	900	675 0	1,200	708 0	7.50	637 10	74.00	592 0
Tin	112.00	824 12 0			1,123	842 5	1,500	885 0	9.70	824 12 6	102.87	822 17 6
Zinc												
Prime western			11.75	97 0 0							11.00	88 0
High grade 99.95			12.35	102 0 0								
High grade 99.99			12.75	105 2 6								
Thermic					126.00	94 12 6						
Electrolytic					134.00	99 12 6	192	113 5	1.05	89 2 6	12.50	100 0

Non-Ferrous Metal Prices (continued)

Ingot Metals

All prices quoted are those available at 2 p.m. 23/9/59

Aluminium Alloy (Virgin)

		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10....	„	221	0	0
B.S. 1490 L.M.11....	„	215	0	0
B.S. 1490 L.M.12....	„	223	0	0
B.S. 1490 L.M.13....	„	216	0	0
B.S. 1490 L.M.14....	„	224	0	0
B.S. 1490 L.M.15....	„	210	0	0
B.S. 1490 L.M.16....	„	206	0	0
B.S. 1490 L.M.18....	„	203	0	0
B.S. 1490 L.M.22....	„	210	0	0

Aluminium Alloys (Secondary)

		£	s.	d.
B.S. 1490 L.M.1	ton	152	0	0
B.S. 1490 L.M.2	„	162	0	0
B.S. 1490 L.M.4	„	178	0	0
B.S. 1490 L.M.6	„	188	0	0

***Aluminium Bronze**

		£	s.	d.
BSS 1400 AB.1......	ton	228	0	0
BSS 1400 AB.2......	„	240	0	0

***Brass**

		£	s.	d.
BSS 1400-B3 65/35 ..	ton	150	0	0
BSS 249............	„	—		
BSS 1400-B6 85/15 ..	„	196	0	0

***Gunmetal**

		£	s.	d.
R.C.H. 3/4% ton	„	—		
(85/5/5/5) LG2	„	186	0	0
(86/7/5/2) LG3	„	195	0	0
(88/10/2/1)..........	„	235	0	0
(88/10/2/½)..........	„	246	0	0

***Manganese Bronze**

		£	s.	d.
BSS 1400 HTB1....	„	181	0	0
BSS 1400 HTB2....	„	198	0	0
BSS 1400 HTB3....	„	210	0	0

Nickel Silver

		£	s.	d.
Casting Quality 12%	„	225	0	0
„ „ 16%	„	232	0	0
„ „ 18%	„	245	0	0

***Phosphor Bronze**

		£	s.	d.
B.S. 1400 P.B.1.(A.I.D. released)..........	„	282	0	0
B.S. 1400 L.P.B.1	„	205	0	0

**Average prices for the last week-end.*

Phosphor Copper

		£	s.	d.
10%	ton	253	0	0
15%	„	255	10	0

Phosphor Tin

		£	s.	d.
5%	„	—		

Silicon Bronze

		£	s.	d.
BSS 1400-SB1	„	238	0	0

Solder, soft, BSS 219

		£	s.	d.
Grade C Tinmans....	„	368	10	0
Grade D Plumbers..	„	296	0	0
Grade M	„	404	10	0

Solder, Brazing, BSS 1845

		£	s.	d.
Type 8 (Granulated)	lb.	—		
Type 9 „	„	—		

Zinc Alloys

		£	s.	d.
Mazak III	ton	116	7	6
Mazak V	„	120	7	6
Kayem	„	126	7	6
Kayem II	„	132	7	6
Sodium-Zinc	lb.		2	7½

Semi-Fabricated Products

Prices vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium

		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8⅛
Sheet 18 S.W.G.	„		2	10⅛
Sheet 24 S.W.G.	„		3	1⅛
Strip 10 S.W.G.	„		2	8⅛
Strip 18 S.W.G.	„		2	9⅛
Strip 24 S.W.G.	„		2	11
Circles 22 S.W.G.	„		3	2⅛
Circles 18 S.W.G.	„		3	1⅛
Circles 12 S.W.G.	„		3	0⅛
Plate as rolled	„		2	8
Sections	„		3	2
Wire 10 S.W.G.	„		2	11½
Tubes 1 in. o.d. 16 S.W.G.	„		4	1

Aluminium Alloys

		£	s.	d.
BS1470. HS10W.				
Sheet 10 S.W.G.	„		3	1
Sheet 18 S.W.G.	„		3	3⅛
Sheet 24 S.W.G.	„		3	11
Strip 10 S.W.G.	„		3	1
Strip 18 S.W.G.	„		3	2⅛
Strip 24 S.W.G.	„		3	10⅛
BS1477. HP30M.				
Plate as rolled......	„		2	11
BS1470. HC15WP.				
Sheet 10 S.W.G.	„		3	9⅛
Sheet 18 S.W.G.	„		4	2
Sheet 24 S.W.G.	„		5	0⅛
Strip 10 S.W.G.	„		3	10⅛
Strip 18 S.W.G.	„		4	2
Strip 24 S.W.G.	„		4	9⅛
BS1477. HPC15WP.				
Plate heat treated..	„		3	6⅛
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	10⅛
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		5	0⅛
BS1476. HE10WP.				
Sections	„		3	1⅛

Brass

		£	s.	d.
Tubes..............	„		1	9¾
Brazed Tubes........	„		2	11¾
Drawn Strip Sections	„		3	0⅛
Sheet	ton	196	0	0
Strip	„	196	0	0
Extruded Bar........	lb.		2	0⅛
Extruded Bar (Pure Metal Basis)	„		—	

Brass

		£	s.	d.
Condenser Plate (Yellow Metal)	ton	190	0	0
Condenser Plate (Naval Brass)	„	202	0	0
Wire	lb.		2	7⅛

Beryllium Copper

		£	s.	d.
Strip	„	1	4	11
Rod................	„	1	1	6
Wire	„	1	4	9

Copper

		£	s.	d.
Tubes	lb.		2	2
Sheet	ton	256	0	0
Strip	„	256	0	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	283	5	0

Cupro Nickel

		£	s.	d.
Tubes 70/30	lb.		3	6⅜

Lead

		£	s.	d.
Pipes (London)	ton	111	5	0
Sheet (London)	„	109	0	0
Tellurium Lead	„	£6 extra		

Nickel Silver

		£	s.	d.
Sheet and Strip 7% ..	lb.		3	7¾
Wire 10%	„		4	2⅛

Phosphor Bronze

		£	s.	d.
Wire	„		4	0

Titanium (1,000 lb. lots)

Billet 4½" to 18" dia...	lb.	54/-	55/-
Rod ¼" to 4" dia.	„	95/-	62/-
Wire ·036" – ·232" dia.	„	167/-	110/-
Strip ·003" to ·048" ..	„	200/-	75/-
Sheet 8'×2'. 20 gauge	„	85/-	
Tube, representative average gauge......	„	300/-	
Extrusions	„	105/-	

Zinc

		£	s.	d.
Sheet	ton	120	15	0
Strip	„	nom.		

Domestic and Foreign

Merchants' average buying prices delivered, per ton, 22/9/59.

Aluminium

	£
New Cuttings	147
Old Rolled	129
Segregated Turnings	102

Brass

	£
Cuttings	155
Rod Ends	143
Heavy Yellow	119
Light	113
Rolled	147
Collected Scrap	115
Turnings	137

Copper

	£
Wire	202
Firebox, cut up	194
Heavy	189
Light	183
Cuttings	202
Turnings	184
Braziery	154

Gunmetal

	£
Gear Wheels	170
Admiralty..................	170
Commercial	154
Turnings	150

Lead

	£
Scrap	61

Nickel

	£
Cuttings	—
Anodes	550

Phosphor Bronze

	£
Scrap	154
Turnings	150

Zinc

	£
Remelted	77
Cuttings	62
Old Zinc	41

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of July, 1959, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follows in long tons:—

COPPER	Gross Weight	Copper Content
Wire	13,756	13,383
Rods, bars and sections	11,744	7,631
Sheet, strips and plate	12,956	10,192
Tubes	7,983	7,340
Castings and miscellaneous	6,370	—
Sulphate	3,200	—
	56,011	44,572

Of which:

Consumption of Virgin Copper	32,034
Consumption of Copper and Alloy Scrap (Copper Content)	12,538

LEAD	
Cables	6,465
Batteries	2,296
Battery Oxides	2,194
Tetra Ethyl Lead	1,837
Other Oxides and Compounds	2,480
White Lead	582
Shot	299
Sheet and Pipe	6,301
Foil and Collapsible Tubes	251
Other Rolled and Extruded	530
Solder	1,360
Alloys	1,088
Miscellaneous Uses	1,168
Total	26,851

TIN	
Tinplate	801
Tinning:	
Copper Wire	38
Steel Wire	7
All other	65
Solder	198
Alloys	415
Foil and Collapsible Tubes, etc.	42
Tin Compounds, Salts, and Miscellaneous Uses	116
Total Consumption	1,682

ZINC	
Galvanizing	7,152
Brass	8,464
Rolled Zinc	1,711
Zinc Oxide	2,236
Zinc Die-casting alloy	4,791
Zinc Dust	1,100
Miscellaneous Uses	864
Total, All Trades	26,318

Of which:

High purity 99·99 per cent	5,366
Electrolytic and high grade 99·95 per cent	4,621
Prime Western, G.O.B. and debased	9,136
Remelted	486
Scrap Brass and other Cu alloys	3,805
Scrap Zinc, alloys and residues	2,741

ANTIMONY	
Batteries	87
Other Antimonial Lead	34
Bearings	30
Oxides—for White Pigments	170
Oxides—other	78
Miscellaneous Uses	12
Sulphides	1
Total Consumption	412

Antimony in Scrap	
For Antimonial Lead	289
For Other Uses	51
Total Consumption	340

CADMIUM	
Plating Anodes	50·10
Plating Salts	9·45
Alloys: Cadmium Copper	2·45
Alloys: Other	3·35
Batteries: Alkaline	7·05
Batteries: Dry	0·30
Solder	5·30
Colours	21·80
Miscellaneous Uses	2·20
Total Consumption	102·00

Scrap Metal Prices

The figures in brackets give the English equivalents in £1 per ton:—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£205.17.6)	235
Heavy copper	(£201.10.0)	225
Light copper	(£170.17.6)	195
Heavy brass	(£118.5.0)	135
Light brass	(£96.12.6)	100
Soft lead scrap	(£56.0.0)	64
Zinc scrap	(£38.12.6)	50
Used aluminium unsorted	(£105.2.6)	120
France (francs per kilo):		
Electrolytic copper scrap	(£198.15.0)	260
Heavy copper	(£198.15.0)	260
No. 1 copper wire	(£183.15.0)	240
Brass rod ends	(£127.12.6)	170
Zinc castings	(£51.0.0)	68
Lead	(£69.0.0)	92
Aluminium	(£129.12.6)	173

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£200.15.0)	340
Aluminium copper alloy	(£135.17.6)	240
Lead, soft, first quality	(£79.0.0)	134
Lead, battery plates	(£44.5.0)	75
Copper, first grade	(£221.5.0)	375
Copper, second grade	(£209.10.0)	355
Bronze, first quality machinery	(£203.2.6)	345
Bronze, commercial gunmetal	(£174.10.0)	295
Brass, heavy	(£147.12.6)	250
Brass, light	(£237.17.6)	225
Brass, bar turnings	(£135.17.6)	230
New zinc sheet clippings	(£65.0.0)	110
Old zinc	(£50.2.6)	85

Financial News

An Acquisition

It has been announced by Murex Welding Processes Limited that they have purchased the whole of the issued shares of Donald Ross and Partners Ltd., of Crawley, specialists in the design and manufacture of mechanical aids to production and in particular the "Twinner" positioners for hand and automatic welding.

While Donald Ross and Partners Ltd. will continue to operate as in the past, and under the same name and the same management, this new association will enable both companies to offer individually and jointly a first-class specialist service to users of welding and to companies contemplating installation of mechanical aids to production.

Trade Publications

Hot Blast System.—The Incandescent Heat Company Ltd., Cornwall Road, Smethwick, Birmingham.

An eight-page coloured folder deals with the Incandescent hot blast system. How this system works, what it is, and what it saves are features of the folder which also includes a number of excellent photographs.

General Chemicals.—Albright and Wilson (Mfg.) Ltd., 1 Knightsbridge Green, London, S.W.1.

This new and crisply designed publication from the General Chemicals department of the company lists close on 400 regular products that are handled every day by the department. These general and fine chemicals are detailed in alphabetical order; a brief description of physical form and the nature of the packs the products are available in is useful additional information.

Welding News. — Suffolk Iron Foundry (1920) Ltd., Stowmarket, Suffolk.

The summer issue of "Sif-Tips" contains a number of interesting welding stories, including one on "Sifbronze for heating units," and another on a new dual-purpose cutting machine. The issue is well illustrated.

Auto - Klean Filters. — Auto - Klean Strainers Ltd., Lascar Works, Hounslow, Middlesex.

This company has just published a new brochure which describes their comprehensive range of filters and illustrates some of their more unusual applications in industrial engineering. After a number of pages dealing with the various types of filters, their construction and operation, other pages deal with their applications in industry. Of particular interest are the pages which describe the efficiency of these filters in rolling mill plant and in connection with oil-fired furnaces. Concise details are given of the installation of these units, together with their function, specifications, etc. The final pages of the brochure are devoted to technical information—technical service, flow data, engineers' tables and the like. Copies of the brochure may be obtained on application to the company.

THE STOCK EXCHANGE

Industrials Active But Rather Irregular In Tone

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 21 SEPTEMBER +RISE—FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1959 HIGH	1959 LOW	1958 HIGH	1958 LOW
£	£			Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	26/1½ —10½d.	9	9	6 17 9	27/4½	23/3	24/9	17/6
400,000	2/-	Anti-Attrition Metal	1/3	4	8½	6 15 0	1/6	1/3	1/9	1/3
41,303.829	Stk. (£1)	Associated Electrical Industries ...	61/- +9d.	15	15	4 18 3	63/6	54/-	58/9	46/6
1,613,280	1	Birfield	58/6	15	15	5 2 6	60/-	46/9	62/4½	46/3
3,196,667	1	Birmid Industries	83/- +1/9	17½	17½	4 4 3	83/-	72/-	77/6	55/3
5,630,344	Stk. (£1)	Birmingham Small Arms	48/- +2/6	11	10	4 11 9	48/3	36/1½	39/-	23/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	16/- +6d.	5	5	6 5 0	16/3	15/-	16/1½	14/7½
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	18/10½	6	6	6 7 0	18/10½	17/9	17/4½	16/6
500,000	1	Bolton (Thos.) & Sons	34/6 +9d.	10	10	5 16 0	34/6	27/6	28/9	24/-
300,000	1	Ditto Pref. 5%	15/- —6d.	5	5	6 13 3	15/6	14/-	16/-	15/-
160,000	1	Booth (James) & Co. Cum. Pref. 7%	20/6	7	7	6 16 6	20/6	20/-	20/4½	19/-
1,500,000	Stk. (£1)	British Aluminium Co. Pref. 6% ...	20/6	6	6	5 17 6	20/7½	18/9	20/-	18/4½
17,247,070	Stk. (£1)	British Insulated Callender's Cables	52/9 +9d.	12½	12½	4 14 9	57/-	46/3	52/6	38/9
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	66/6 +1/-	10	10	3 0 3	66/9	49/3	52/-	28/3
1,200,000	Stk. (5/-)	Canning (W.) & Co.	14/6	25+*2½C‡	25	4 6 3	16/-	12/3	25/3	19/3
60,484	1/-	Carr (Chas.)	2/6xd	12½	25	5 0 0	2/10½	1/3	2/3	1/4½
555,000	1	Clifford (Chas.) Ltd.	26/3xd	10	10	7 12 6	27/-	22/6	22/-	16/-
45,000	1	Ditto Cum. Pref. 6%	17/-	6	6	7 1 3	16/9	15/3	16/-	15/-
250,000	2/-	Coley Metals	3/-	15	20	10 0 0	4/-	2/10½	4/6	2/6
10,185,696	1	Cons. Zinc Corp.†	64/3 +6d.	15	18¾	4 13 3	69/3	59/-	65/3	41/-
1,509 528	1	Davy & United	81/6 +2/6	30‡	20	3 13 6	81/6	43/1½	87/-	45/9
6,840,000	5/-	Delta Metal	18/-	31‡	30	4 6 0	18/-	12/-	25/-	17/7½
5,296,550	Stk. (£1)	Enfield Rolling Mills Ltd.	55/- —1/7½	15	12½	5 9 0	57/6	36/7½	38/-	22/9
750,000	1	Evered & Co.	35/9	10 §	15 Z	5 12 0	35/9	30/-	30/-	26/-
18,000,000	Stk. (£1)	General Electric Co.	40/-	10	10P	5 0 0	40/3	30/-	40/6	29/6
1,500,000	Stk. (10/-)	General Refractories Ltd.	37/9 +1/-	20	20	5 6 0	40/-	32/6	29/3	27/3
401,240	1	Gibbons (Dudley) Ltd.	63/6	16½	15	5 4 0	66/6	63/6	67/6	61/-
750,000	5/-	Glacier Metal Co. Ltd.	8/3 +3d.	11½	11½	6 19 6	9/3	6/7½	8/3	5/-
1,750,000	5/-	Glynwed Tubes	22/3xd +1½d.	20¶	20	4 10 0	23/-	16/4½	18/1½	12/10½
5,421,049	10/-	Goodlass Wall & Lead Industries ...	40/3	13‖	18Z	3 4 6	40/3	28/7½	30/9	17/3
342,195	1	Greenwood & Batley	105/-	30	20	5 14 3	108/3	75/-	57/9	45/-
396,000	5/-	Harrison (B'ham) Ord.	19/10½	*17½	*15	4 8 0	20/-	14/11½	15/9	11/6
150,000	1	Ditto Cum. Pref. 7%	19/6	7	7	7 3 6	19/6	19/3	19/9	18/4½
1,075,167	5/-	Heenan Group	10/- +3d.	10	10‡	5 0 0	10/6	7/6	9/7½	6/9
236,958,260	Stk. (£1)	Imperial Chemical Industries ...	42/3 +1/3	12Z	10	3 15 9	42/9	33/9	38/-	24/3
34,736,773	Stk. (£1)	Ditto Cum. Pref. 5%	17/1½	5	5	5 16 9	17/9	16/-	17/1½	16/-
14,584,025	**	International Nickel	171 —2	$2.60	$3.75	2 17 0	187¾	154½	169	132¾
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3xd	5	5	6 3 0	16/3	15/4½	16/9	15/-
6,000,000	1	Ditto Ord.	42/- —1/-	12D	10	3 16 3	44/3	29/7½	47/-	36/6
600,000	10/-	Keith, Blackman	31/3	17½E	15	4 7 0	31/3	25/-	28/9	15/-
320,000	4/-	London Aluminium	6/4½	10	10	6 5 6	6/9	5/3	6/-	3/-
765,012	1	McKechnie Brothers Ord.	45/- +1/3	15	15	6 13 3	45/-	41/-	45/-	32/-
1,530,024	1	Ditto A Ord.	43/- +1/-	15	5	6 19 6	43/6	38/9	45/-	30/-
1,108,268	5/-	Manganese Bronze & Brass	14/6	20⅝	20	7 3 6	16/3	13/9	14/1½	8/9
50,628	6/-	Ditto (7½% N.C. Pref.)	6/-	7½	7½	7 10 0	—	—	6/3	5/6
13.098,855	Stk. (£1)	Metal Box	63/3 +9d.	11	11	3 9 6	63/3	44/7½	73/3	40/6
415,760	Stk. (2/-)	Metal Traders	11/3 —3d.	50	50	8 17 9	12/3	8/4½	9/-	6/3
160,000	1	Mint (The) Birmingham	28/-	10	10	7 2 9	28/-	22/-	22/9	19/-
80,000	5	Ditto Pref. 6%	80/-	6	6	7 10 0	75/6	69/-	83/6	69/-
3,705,670	Stk. (£1)	Morgan Crucible A	57/6	10	10	3 9 6	58/6	43/6	45/-	34/-
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	18/-	5½	5½	6 2 3	18/6	17/6	18/-	17/-
2,200.000	Stk. (£1)	Murex	52/3 +1/6	15	17½	5 14 9	52/3	41/-	58/9	46/-
468,000	5/-	Ratcliffs (Great Bridge)	12/- +6d.	10R	10	3 2 6	12/-	9/6	11/1½	6/10½
234,960	10/-	Sanderson Bros. & Newbould ...	41/-	25	20	6 2 0	41/-	27/9	27/3	24/6
1.365,000	Stk. (5/-)	Serck	23/7½ +7½d.	15	17½	3 3 6	23/7½	18/-	18/7½	11/-
6,698,586	Stk. (£1)	Stone-Platt Industries	50/3 —1/-	15	15	5 19 6	53/6	42/6	45/6	22/6
2,928,963	Stk. (£1)	Ditto 5½% Cum. Pref.	17/9 +3d.	5½	5½	6 4 0	18/-	15/10½	16/3	12/7½
18,255,218	Stk. (£1)	Tube Investments Ord	94/- +4/-	17½	15	3 14 6	94/-	72/-	86/-	48/4½
41,000,000	Stk. (£1)	Vickers	28/6 —2/-	10	10	7 0 3	37/-	28/1½	36/3	28/9
750,000	Stk. (£1)	Ditto Pref. 5%	15/-	5	5	6 13 9	15/0¾	14/3	15/9	14/3
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	22/6	*5	*5	6 12 9A	22/7½	20/6	23/-	21/3
2,200,000	1	Ward (Thos. W.), Ord	99/- —1/-	20	15	4 0 9	101/-	83/-	87/3	70/9
2,666,034	Stk. (£1)	Westinghouse Brake	49/- +9d.	10	10	4 1 9	49/-	39/9	46/6	32/6
225,000	2/-	Wolverhampton Die-Casting ...	9/9	30	25	6 3 0	10/6	8/8½	10/1½	7/-
591,000	5/-	Wolverhampton Metal	29/- —9d.	27½	27½	4 14 9	32/3	21/6	22/9	14/9
78,465	2/6	Wright, Bindley & Gell	6/7½ —1½d.	20	20	7 11 0	7/1½	4/11½	5/4½	2/9
124,140	1	Ditto Cum. Pref. 6%	13/9	6	6	8 14 9	13/9	13/6	13/-	11/3
150,000	1/-	Zinc Alloy Rust Proof	3/1½	27	40D	8 12 9	3/9	2/9	3/1½	2/7½

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting. **Shares of no Par Value. ‡ and 100% Capitalized issue. ● The figures given relate to the issue quoted in the third column. A Calculated on £7 8 9 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. ϕ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits. E and 50% capitalized issue in 7% 2nd Pref. Shares. P Interim dividend since reduced. § And Special distribution of 2½% free of tax. R And 33⅓% capitalized issue in 8% Maximum Ordinary 5/- Stock Units. ¶ Interim since increased from 10% to 11%.

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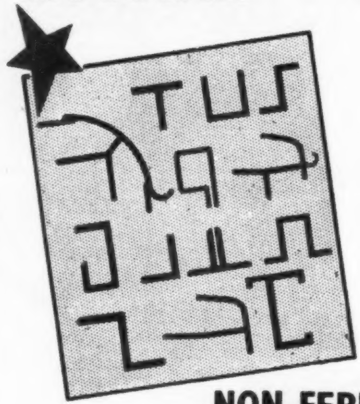

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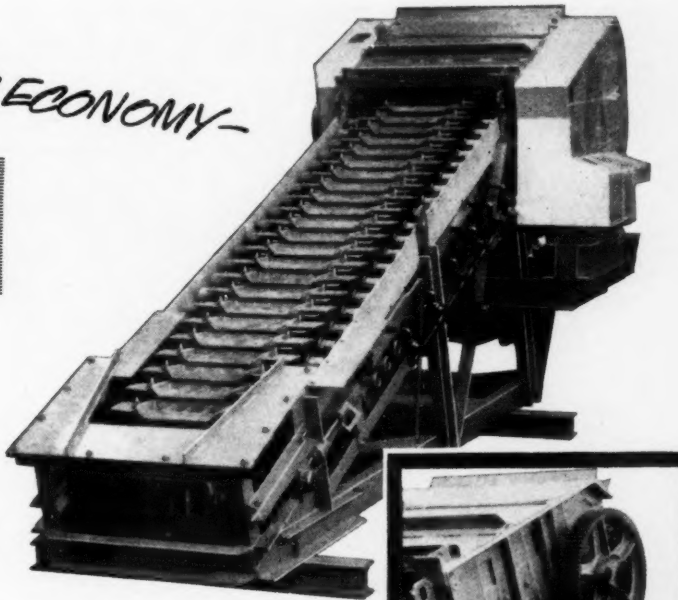

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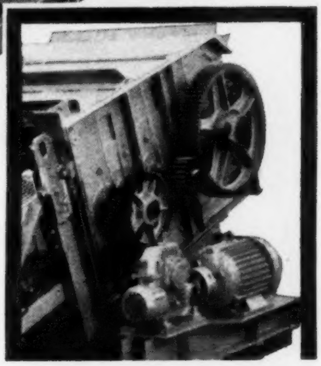

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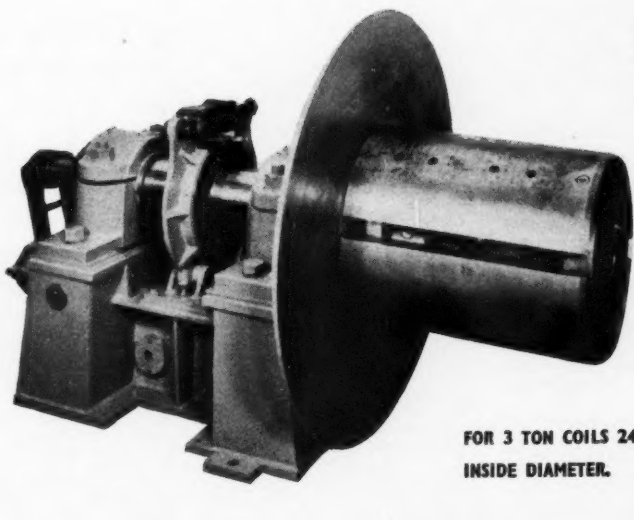

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